

N O T I C E

THIS DOCUMENT HAS BEEN REPRODUCED FROM
MICROFICHE. ALTHOUGH IT IS RECOGNIZED THAT
CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED
IN THE INTEREST OF MAKING AVAILABLE AS MUCH
INFORMATION AS POSSIBLE

SOLVING INDUSTRIES' MANUFACTURING PROBLEMS THROUGH AEROSPACE TECHNOLOGY

Report No. IITRI-J6499 — 2nd Quarter 1980 Program Year

MANUFACTURING PROCESS APPLICATIONS TEAM

(MATEam)

Mr. James H. Ehl, Chief
Tooling Applications Branch
Materials and Processes Lab (EH 44)

Prepared by

Edmund R. Bangs
IIT Research Institute
10 West 35th Street
Chicago, Illinois 60616

August 1980

ORIGINAL
COLOR ILLUSTRATIONS

1. SUMMARY

This is the Second Quarterly Report for the 1980 MATeam Program. Activities during the reporting period have been concentrated on the screening of new manufacturing problems in addition to presentations to government agencies and selected industrial organizations. Progress continued on potential RTOPs and direct technology transfer programs identified earlier.

A total of 28 manufacturing problems considered of serious magnitude have been identified at the Rock Island Arsenal. The preparation of problem statements and screening of potential NASA problem solving technology is underway.

The Naval Air Rework Facility System continues to expand interest in technology transfer and NASA Manufacturing Technology. They are interested in utilizing the NASA laser, tube flaring, and heat transfer technology to solve existing aircraft overhaul problems.

An electronic monitoring system is being developed at the MSFC that has the potential to reduce the electronic inspection time in the production of dishwashers. The system enables rapid checkout of the washer electronic controls. In addition to improving washer productivity, the cost saving is estimated at \$218,000 per year.

An RTOP pertaining to the application of NASA Infrared sensor technology to Robot positioning has been forwarded to NASA Headquarters for consideration. The world's largest supplier of robots, Unimation Inc., has agreed to joint-fund the proposed three-year program.

During the first week in June a MATeam program review was given as part of the technology utilization conference conducted at the Goddard Space Flight Center (see Appendix 1).

A revision to the MATeam brochure was made during this reporting period and this updated brochure is presently being made available to potential industry participants (see Appendix 2). The brochure is directed at answering the frequent questions that arise related to the transfer of NASA manufacturing technology.

2. TECHNICAL PROGRESS

2.1 Government Agency and Industry Contacts

The MATEam continued to expand and strengthen its communications with government agencies and industrial organizations. During the second quarter, presentations, plant visits and problem review meetings have been conducted with government agencies and companies that maintain a major position in their industries. The industries represented included aircraft components, off-the-road equipment, and electrical connectors.

In May a presentation and problem review meeting was conducted at the Hamilton-Standard Division of United Technologies facility. Manufacturing problems were reviewed with 15 engineering staff personnel representing metallurgy, inspection, production, and marketing. Problems reviewed were related to major manufacturing problems which are being encountered in the F-15 and F-16 aircraft production. The problems include the machinability of superalloys, powder metallurgy, adaptive controlled welding systems, and the application of robotics in propeller manufacturing. If potential NASA problem solving technology can be identified, they have sufficient budget and have proposed a joint-funded program between NASA, The Department of Defense, and Hamilton-Standard.

Enclosure 1 contains a listing of the presentations and plant visits made during the reporting period. An abbreviated version of the MATEam Program Review (Appendix 1) was given on June 4 at the Technology Utilization Conference conducted at the Goddard Space Flight Center. The presentation highlighted the MATEam goals and accomplishments since the start of the program.

On June 17 and 18, the MATEam returned to the Army's Rock Island Arsenal for detailed manufacturing problem review meetings. Personnel involved included engineering and quality assurance representatives connected with the manufacturing operations section. There was a total of 28 manufacturing problems reviewed. The MATEam is presently preparing problem statements, screening the problems for uniqueness, and pursuing potential NASA problem solving technology.

Areas of concern included: the need for energy saving devices, automatic welding systems, the inspection of machined parts during

machining, heat treating of tow rings, electroplating, parts cracking during heat treating, foundry chemistry control, repairing pitted surfaces on large caliber barrel surfaces, water treatment, noise control, heat treating using synthetic quenching media, and the analysis of hydraulic fluid for metallic and nonmetallic particles.

During the Arsenal meetings, a transportation oriented problem was identified. Rubber pads are attached to the tracks of Army Tanks to protect concrete pavements from destruction when operating on streets, highways, and bridges. Present rubber pad materials have a short life span of anywhere from 20 miles to 200 miles. Some pads break up shortly after installation. What is needed is an improved rubberized material that will withstand the heavy weight and rigorous turning operations. The arsenal has identified Firestone as the present and possible future manufacturing source of any candidate NASA material. Since the problem is strongly transportation oriented, the problem statement has been sent to James P. Wilhelm, Director of the NASA Technology Application Team, at SRI.

In June the production planning activity at the Naval Rework Facility at Norfolk defined additional manufacturing problems in a visit to the MATEam at IITRI. Most notable of the problems defined and potential solutions relates to the machining of hard to machine alloys. Facility engineering personnel have developed a cutting tool concept that utilizes NASA heat pipe technology. As shown in Enclosure 2, the heat pipe aids in the conduction of heat from the cutting tool. It is envisioned that cooling the cutting tool will reduce heat buildup at the cutting edge which is a major contributor to tool wear.

During the first week in July a presentation and problem review meeting was conducted with the Manufacturing Research and Development Section of the Caterpillar Tractor Company (E. Peoria). There was a total of 12 engineering staff at the meeting. Problems and areas of interest discussed were related to robot technology, nondestructive testing, fasteners, ion beam technology and computer-aided design. A major problem at Caterpillar is robot safety. Therefore, there was accelerated interest in NASA sensing and priority technology. Caterpillar is also strengthening its

fastener evaluation laboratory and will use the NASA Goddard handbook related to strength analysis in nuts and bolts as a guide in developing test equipment for the laboratory.

During the third week of July, a presentation and problem review was conducted with the Allen-Bradley Company Manufacturing Research and Development staff. The Milwaukee-based organization is one of the world's major manufacturers of electrical switch systems. The meeting was attended by approximately 20 engineering personnel representing manufacturing, project engineering, research, quality assurance and design engineering. A problem of concern at Allen-Bradley is the application of sensor technology to new generation switching applications. A review of tactile, vision, infrared and vocal sensing technology developed at Jet Propulsion Laboratory is underway.

As a result of the Milwaukee meeting, a visit to JPL by Allen-Bradley engineering personnel is presently being scheduled so they may personally review the NASA-funded robot technology.

An updated version of the MATEam brochure was prepared during the reporting period (see Appendix). The intent of the brochure is to describe how the transfer of manufacturing technology takes place. In addition to describing the transfer process, it discusses some of the frequently asked questions related to program participation. The rear portion of the brochure contains illustrations of technology that has been transferred or is in the process of transfer. This section of the brochure will be revised from time to time without cause to reproduce the entire document. It is anticipated that the brochure will attract more industrial sector participants to the program.

3. TECHNICAL RESULTS AND PROGRESS

3.1 Research and Technology Objectives and Plans (RTOPs)

The MATEam continued to concentrate activity during the reporting period on the identification of RTOP programs with government agencies and with companies whose problems are reflective of the industry they represent. A summary discussion of the potential RTOP programs supportive activities follows.

Industrial Application of the Orbital Tube Flaring Device - MAT-168

Consideration of the Grotnes proposal for modification of an orbital device for the Navy by MSFC and the Naval Rework Facility at San Diego has been discouraged at this time due to price. The Teledyne Patent which is in its final year has also been a discouraging factor.

The orbital tube devices marketed by Conrac Corp. and Olson Mfg. Company incorporate an eccentric orbital system. Conversations with both companies indicate, that while the systems are similar, the NASA design has the capability of holding a tighter tolerance thereby providing a superior flare.

The flaring of small diameter tubes at the Naval Air Rework Facility (North Island) continues to be a problem. In order to help solve this critical manufacturing problem, the tube flaring system at MSFC will be loaned to the Rework Facility. A letter requesting loan of the system (Enclosure 3) has been sent to MSFC by the Commanding Officer of the North Island Rework Facility. Manufacturing personnel actively involved in overhaul of F-4 fighter aircraft are eagerly awaiting receipt of the system.

The Laser Wire Insulation Stripping System - MAT-175

New and improved high temperature wire insulation has rendered new interest in the NASA Laser Wire Stripper, NASA SP-5107. Two Naval Rework Facilities, Norfolk and Long Beach, along with the Westinghouse Electric Company have expressed their need for the system.

The Naval Rework Facilities plan using the Laser Stripper for rework on fighter aircraft, while the need of Westinghouse is for stripping heavy cable used in transformers.

Preliminary work is underway by two of the parties. Westinghouse has sent samples to their laboratory facility, Westinghouse Defense Center, to determine the feasibility and size power unit needed. Initial tests show that laser stripping is possible using a 20-25 watt power unit. The Naval Rework Facility at Long Beach has requested funding from Navy Headquarters for the purchase of a duplicate NASA system.

The stripping system needed by Westinghouse will require additional application engineering. Modifications to the stripping head are necessary because of the cable size and configuration. The modification work will be accomplished in-house by Westinghouse personnel. Westinghouse is studying the NASA drawings for quoting and building duplicate NASA laser strippers for both Naval Rework Facilities.

The Non-Destructive Measurement of Fracture Tougheners - MAT-246

The MATeam continues to support non-destructive fracture toughness testing underway at LeRc, RTOP 141-95-01-12. Regal Tube Division of Copperweld (Chicago), a major supplier of welded tube has a problem in measuring fracture toughness in plate prior to the forging and welding operation of tubes. Regal is interested in a nondestructive method that can be used in all plate prior to forging and welding so they may be sure upon completion of forming and welding, that the tube has the required toughness properties.

The ultrasonic method for ranking fracture toughness nondestructively, devised by Alex Vary at LeRC; N75-29241, N75-30606 and N76-21319, is a unique NASA technology. Ultrasonic waves are introduced into a specimen, and ultrasonic velocity and attenuation measurements are made. The measured data are used in an equation to estimate a proportionality coefficient for the material being investigated by comparison with known fracture-toughness values (K_{Ic}).

Tests made on the samples that the Regal Tube Company forwarded to LeRC show that correlations of sound wave attenuation with K_{Ic} is possible. However, many tube structural specifications require a drop-weight tear test (DWTT) in accordance with ASTM E-436. The DWTT shear area measurements of E-436 do not directly correspond to the E-399 K_{Ic} fracture toughness measurements. Mechanical test data related to samples forwarded to LeRC has been requested of Regal Tube, so possible correlation can be made between K_{Ic} and DWTT.

Biodigestion Methane Gas Generation - MAT-291

The Naval Air Rework Facility (NARF) at Norfolk continues to be interested in a joint-funded RTOP for developing the NASA Anerobic Digestion System, "Fuel Gas from Biodigestion," MFS-23937. The system will be applied to selected heat treating furnaces at the Rework Facility, having the ultimate goal of reducing the 1.0 to 1.5 million cubic ft. of natural gas used annually for heat treating requirements.

A prototype laboratory system has been designed and assembled at NSTL. The design incorporates the use of a solar panel for maintaining a constant temperature. Minor problems have been resolved and final tests are underway. The first test will determine the size unit needed to produce sufficient methane gas to operate one heat treating furnace at the Norfolk Facility. A meeting, presently scheduled for the first part of September, will be set up between NSTL and NARF to go over RTOP Program Details. The RTOP will then be forwarded to NASA-Headquarters for consideration.

The Application of Sensor Technology for Robot Positioning in Automobile Manufacturing - MAT-293

The requirement for accurately positioned parts on the production transfer system has created excessive tooling and robot costs. A sensing system is needed that will sense the position of the part to be fabricated and accurately inform the robot of the part's position. NASA vision proximity devices developed by JPL under Contract NAS7-100 appear to

provide a potential solution to the problem. An artist's concept of a proximity device application appeared in the MATeam 1979 final report.

The application of proximity ranging systems to robot control provides a solution to the typical industrial robot control problems discussed above. A proximity ranging system can determine position and orientation errors of parts located on a transfer system and inform the robot of these errors so that the robot control system can adjust the robot actions accordingly (e.g., a proximity ranging system utilizing three beams has the ability to measure the distance and the two orientation angles of a plane relative to another {reference} plane.) Or, a proximity ranging system mounted to a robot arm can determine if the die in process forming operations has been emptied. If the die set is not clear, the sensor system will signal stop to the robot.

The proposed application of proximity ranging technology to industrial robot control problems will increase robot productivity by decreasing tooling costs and costly damages that occur when robots are operated without sensors that could respond to changing environmental conditions.

An RTOP has been prepared by Dr. A. K. Bejczy of the Jet Propulsion Laboratory and has been submitted to NASA Headquarters for Joint funding consideration.

The overall objectives are the development, demonstration and evaluation of a prototype proximity ranging system for industrial robot control applications. The ranging system will be capable of detecting the presence of an object at a given location, and measure the distance and the two orientation angles of a plane relative to another (reference) plane. The sensor system will utilize a microprocessor for data processing, and the sensor data can be utilized for computer control of an industrial robot arm. The sensor system data handling parameters will be programmable so that system response can be adjusted to global changing task conditions. The hardware parameters of the system (optics and electronics) will match the general application requirements which will be determined during the first phase of the overall task.

The specific FY -81 objectives are: (1) Conduct an application survey in detailed parametric terms. The output parameters (geometric characteristics

IIT RESEARCH INSTITUTE

and surface properties of objects to be handled in a typical industrial robot environment, typical distances and angles to be measured, etc.) are needed for alternative conceptual sensor system designs. (2) Develop alternative conceptual proximity ranging system designs. (3) Select the most promising and cost-effective design. (4) Initiate breadboard development of the selected design.

The objectives of the RTOP will be accomplished by utilizing the knowledge base and laboratory experience in proximity ranging technology developed at JPL during the past six years for space applications, in particular for the control of the Space Shuttle Remote Manipulator System. The JPL/NASA technology in the area of proximity ranging systems is described in the following references: 1) A. K. Bejczy, Smart Sensors for Smart Hands, Progress in Astronautics and Aeronautics, Vol. 67, pp. 275-304, AIAA Publ., New York, N.Y., 1979. 2) A. K. Bejczy, Sensor and Computer Aided Control of Manipulators in Space, Proceedings of IEEE MIDCON/79, Chicago, Ill., November 608, 1979. 3) A. K. Bejczy, J. W. Brown and J. L. Lewis, Evaluation of Proximity Sensor Aided Grasp Control for Space Shuttle Remote Manipulator System, Proceedings of the 15th Annual Conference on Manual Control, Wright State University, Dayton, OH, March 20-22, 1979. (4) A. K. Bejczy, J. W. Brown and J. L. Lewis, Evaluation of Smart Sensor Displays for Multidimensional Precision Control of Space Shuttle Remote Manipulator, Proceedings of the 16th Annual Conference on Manual Control, MIT, Cambridge, MA, May 5-7, 1980. The sensor/control prototype development and demonstration will be done in two major phases in cooperation with Unimation Inc., a major builder of industrial robots in the world.

The overall program is scheduled to be performed over a 36-month time period at an overall estimated value of \$500 K. Unimation has committed to contribute \$180 K in manpower and facilities during the three-year program period.

The Control of Fusion Welding Processes Using Infrared Imaging - MAT-294

The real time fusion welding control discussed in the MATeam 1979 final report and the first quarterly report of 1979, is presently being reviewed by the Honeywell Technology Strategy Center in Norville, Minnesota.

IIT RESEARCH INSTITUTE

Honeywell is actively involved in infrared technology and is interested in new product areas with strong market potential. They are aware of the need for improved automated welding systems. They have reviewed the proposed concept and are interested in pursuing its development further. A meeting is planned for September at IITRI, at which time an applications engineering program will be planned.

The Repair of Electrical Cable Assemblies - MAT-302

The Army at the Rock Island Arsenal requires a solvent that will dissolve or break down the polyurethane water-proof coating on electrical cable assemblies used in air defense systems. The polyurethane coating becomes hard and brittle with age, cracks, and therefore exposes the electrical wires rendering the cable assembly vulnerable to electrical failure. Replacement of the cables by present suppliers takes 18 months. Therefore the Army is reworking the cable assemblies themselves. In order to rework the assemblies, a commercially available solvent is used to break down or dissolve the polyurethane coating. The solvent, Dynosolve MP-500, has a slow reaction time, making rework a time-consuming process.

The Ames Research Center believes a hydrazine base solution or ammonia gas will have a faster reaction time than commercially available solvents. Cable assembly connectors have been received at ARC for testing to determine what effect hydrazine or ammonia gas will have on the metal connector and insulating material surrounding the connector pins. The insulating material is any one of three materials, neoprene, butyl rubber, or silica, with a majority of the connectors using neoprene as the insulator.

According to engineering personnel at Rock island, should hydrazone or any other solvent suggested by NASA, for removal of the polyurethane protective coating, have an adverse effect on the insulating material, the specifications for insulating material can be changed.

Tests are presently underway at ARC in order to find a potential solution to the Army's problem.

The Testing of Electronic Circuitry in Automatic Appliances - MAT-303

The Whirlpool Corporation needs an electronic inspection device that will reduce the time required to perform electrical quality assurance checkouts on automatic dishwashers during the final inspection process. The equipment required must be capable of increasing the number of units presently checked per hour from 1600 to 2000 without expanding present facilities.

Mr. James C. Currie at MSFC responded to the problem. Mr. Currie is currently developing a prototype computerized tester for a NASA application which he believes will also serve the needs of Whirlpool.

Whirlpool, encouraged by their initial conversations with Mr. Currie, plan to visit MSFC once the prototype is completed. This is scheduled for late September.

Sensor for Measuring Air Flow Through Engine Cooling Systems - MAT-306

Recent contact with International Harvester identified the need for a sensing system to measure air flow through radiator ducts for internal combustion engines. Many of the engines are used to power pumps and similar equipment.

The air flow measuring device will enable design engineers to test fan performance under actual operating conditions, allow accurate placement of the fan in its shroud, and reduce the noise level caused by improper fan placement. Enclosure 4 contains a conceptual sketch of how the sensor will monitor cooling air flow.

A copy of the problem was sent to the NASA centers. Mr. Gale Sundberg at LeRC proposed using sensors being developed at the University of Cincinnati, under NASA Grant NSG-3022. The Grant involves the development of a highly sensitive deep impurity semiconductor bridge, which can be used as an anemometer or gas flow meter. Additional development work is still needed and the University has not assigned anyone to complete the work. This work has been a spin-off of deep trap studies in silicon and silicon-germanium alloys by the University for NASA-LeRC. It has been funded, to a large extent, by the Ohio Medical Company and directed toward medical applications.

JIT RESEARCH INSTITUTE

Mr. Sundberg, project manager, recommends that the LeRC TU Officer consider funding this added development.

Copies of the correspondence received from LeRC are being reviewed by International Harvester for possible implementation.

The Paint Build-Up on "C" Hooks - MAT-310

Star or "C" hooks are used by the Whirlpool Corporation to hang appliance sheet metal enclosures while proceeding through the electrolytic spray painting process conveyor system. The problem is a paint build-up on the hooks which flakes off onto the wet painted surface which then requires repainting. Coating the hook so that it will not support paint build-up may be a solution.

A solution to the paint build-up problem has the potential of reducing production labor costs by an estimated \$80,000.00 per year.

A sample "C" hook has been sent to Dr. Parker at the Ames Research Center. Dr. Parker is looking for NASA Paint Technology that may be applicable. NASA's experience in application of plastics and thin film technology are a few of the areas being screened.

4. TRANSFERRED TECHNOLOGY DISSEMINATION ACTIVITIES

The Transferred Technology Dissemination Activity Section of our quarterly reporting is new. The intent of this section is to highlight the continuing dissemination and follow-on activities and the industrial sector impact of manufacturing technology in which MATeam has played a significant role in initially transferring. This activity provides continuity for transferred NASA manufacturing technology and is not felt to be in conflict with other TU programmatic efforts; but complements these efforts.

The Rock Island Arsenal Machining Facility utilizes mills, grinders, boring mills, etc., that require the use of 440 volt 3-phase A-C motors of 6 HP or greater. The arsenal is looking for means to reduce the electrical energy consumed in their machine shops. It was indicated that the NASA Power Factor Controller could provide the means of reducing the

power consumed by the Arsenal's machine shops. A list of NASA licensees was provided to the cognizant engineering personnel.

Further dissemination of the NASA Power Factor Controller continues to take place. As a result of the direct transfer to Furnas Electric through the MATEam, manufacturers of electrically operated equipment are including the AC Motor Controller as a built-in option. One such manufacturer is Walsh Press Company in Chicago. The Walsh Press Company is offering the AC Motor Controller as an option on their OBM Punch presses. The punch press is a Walsh Model 20X, or 20 top deep throat fly wheel with an air clutch. The press has a variable speed from 200 to 600 strokes per minute and uses a 220 volt, 5 HP motor. Walsh is showing the machine at the International Machine Tool Show being held in Chicago during the first and second week of September, 1980.

5. FUTURE PLANS

5.1 Presentations and Press Releases

Industry associations and organization contacts planned during the next reporting period include:

- . National Tool, Die and Precision Machining Association
- . American Society of Heating, REfrigeration and Air Conditioning Engineers, Inc.
- . Association of Home Appliance Manufacturers
- . Forging Industry Association.

Enclosure 5 includes a press release which has been issued to over 50 monthly technical journals and newspapers. The new elastomer material was developed at the University of Utah while under contract to NASA. The material contains unique properties with strong oxidation resistance and thermal stability to 600°F.

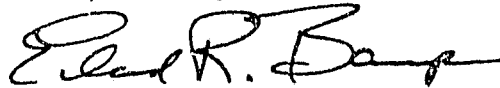
6. SUMMARY

MATEam contact with the Naval Rework Facility System has uncovered a number of manufacturing problems that require rapid solution. In addition, contact with the System has revealed funding sources that are more readily available for applications engineering programs.

IIT RESEARCH INSTITUTE

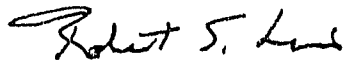
A major factor in the continued growth in credibility of MATEam is its responsiveness in identifying solutions to problems. The capability of other government agencies to utilize NASA technology and equipment to solve problems has the potential of providing a responsiveness that will have a strong favorable impact on our credibility.

Respectfully submitted



Edmund R. Bangs
MATEam Director

APPROVED:



Robert S. Levi
Manager
Technology Transfer and
Market Research Section

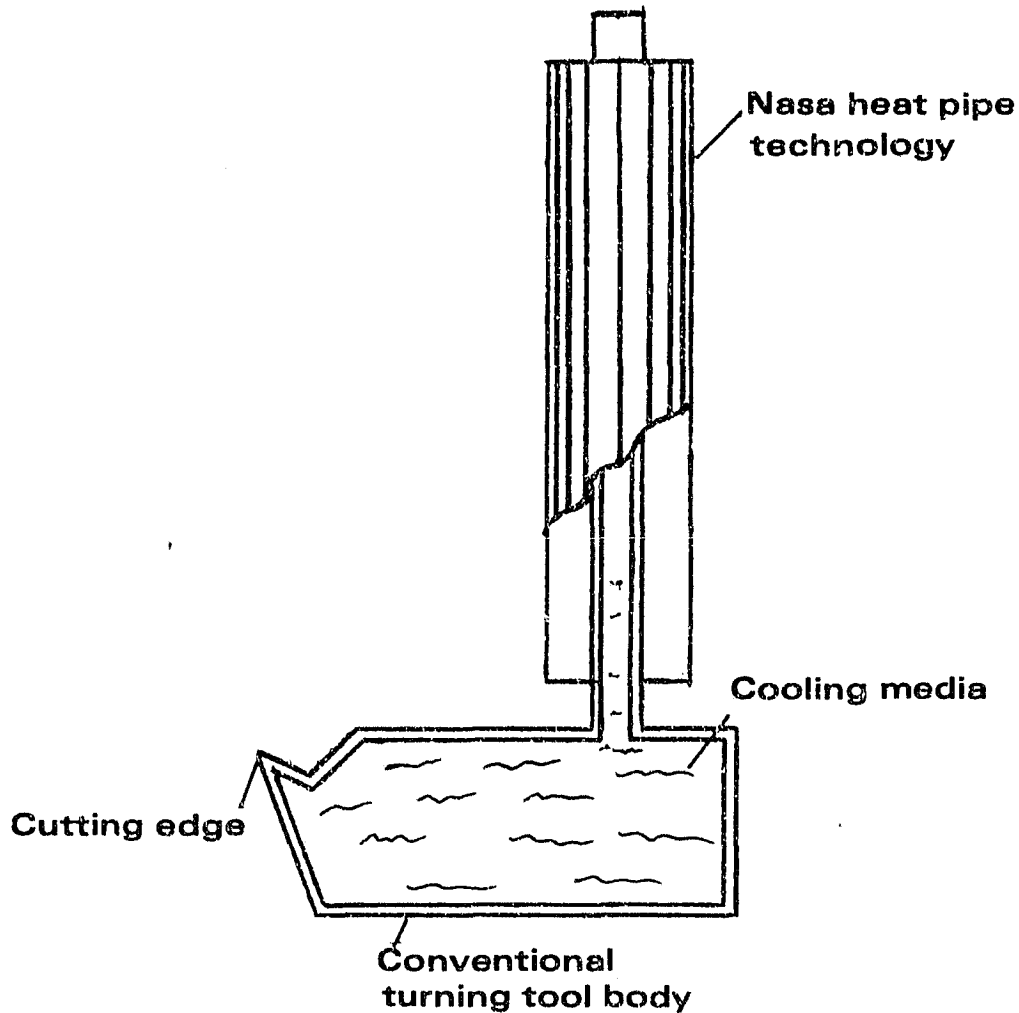
ERB:ds

MATeam Presentations and Plant Visits

May 12, 1980	Hamilton-Standard Windsor Locks, CT
June 17-18, 1980	Rock Island Arsenal Rock Island, IL
June 24, 1980	Naval Air Rework Facility Norfolk, VA
July 2, 1980	Caterpillar Tractor E. Peoria, IL
July 17, 1980	Allen-Bradley Co. Milwaukee, WI

Enclosure 1.

THE APPLICATION OF NASA HEAT PIPE TECHNOLOGY TO COOLING METAL CUTTING TOOLS



ADVANTAGES

- a) INCREASED PRODUCTIVITY
- b) MACHINING DIFFICULT TO MACHINE ALLOYS
- c) EXTENDED TOOL LIFE



NAVAL AIR REWORK FACILITY
NAVAL AIR STATION
NORTH ISLAND
SAN DIEGO, CALIFORNIA 92135

IN REPLY REFER TO:
61222/SM:rb
Ser 9092

26 AUG 1980

From: Commanding Officer, Naval Air Rework Facility, Naval Air Station,
North Island
To: National Aeronautics and Space Administration, Marshall Space Flight
Center, Alabama 35812, (Mr. J. E. Kingsbury, Director Science
Engineering, Code EA01)

Subj: Orbital Tube Flaring System

Ref: (a) FONECON between Mr. A. D. Smith, NASA/Mr. S. Montoya,
NAVAIREWORKFAC, North Island on 15 July 1980
(b) FONECON between Mr. Wall and Mr. Wiggins, NASA/Mr. Montoya,
NAVAIREWORKFAC, North Island on 16 July 1980
(c) FONECON between Mr. E. R. Bangs, NASA/Mr. R. L. Davidson,
NAVAIREWORKFAC, North Island on 21 July 1980

1. In the past, fluctuations in the quality of tubes manufactured at NAVAIREWORKFAC, North Island has led to our pursuit of the newest concepts in tooling available. The technology gained by the National Aeronautics and Space Administration (NASA) in the tube flaring area has been the subject of communications between NASA/Navy personnel.

2. During reference (a), the drawing for the Orbital Tube Flaring System were requested. As these drawings are not available, the loan of the system was discussed in subsequent telephone conversation, reference (b).

3. During reference (c), an eighteen (18) month loan of an existing Orbital Tube Flaring System controlled by NASA was discussed. Pursuant to reference (c), it is requested that the Orbital Tube Flaring System be loaned to NAVAIREWORKFAC, North Island for testing and evaluation. The following shipping information is provided:

NAVAIREWORKFAC North Island
Building 825-3
Mr. S. Montoya, Code 61222
San Diego, CA 92135

Enclosure 3.

61222/SM:rb

Ser 9092

26 AUG 1980

Subj: Orbital Tube Flaring System

4. If additional information is required contact Mr. S. Montoya by commercial telephone (714) 437-7312.

L. S. Mordecai
L. S. MORDECAI
By direction

Copy to:

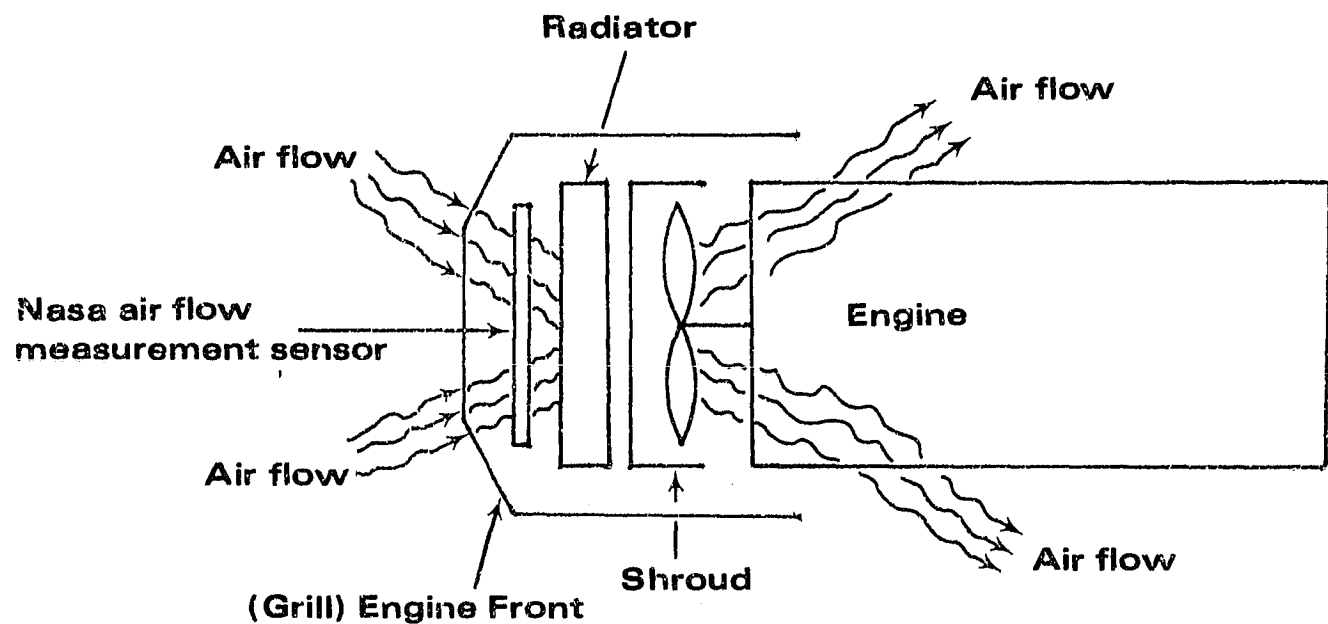
NASA, Code EH44, Mr. R. Swinghammer

NASA, Code EH44, Mr. J. Ehl

NASA, Code AT01, Aubrey D. Smith

ITT Research Institute (MATEAM), ~~10 West 35th Street, Chicago, IL 60616~~
10 West 35th Street, Chicago, IL 60616
(ATTN: E. R. BANGS)

THE APPLICATION OF NASA AIRFLOW SENSOR TECHNOLOGY TO ENGINE COOLING SYSTEM DESIGN



SENSOR AIDS IN:

- a) DESIGN IN TRANSFER OF COOLING AIR
- b) DESIGN OF GRILL, FAN, AND RADIATOR
- c) REDUCING ENGINE OPERATING TEMPERATURE



IIT Research Institute
10 West 35 Street, Chicago, Illinois 60616
312/567-4000

NEWS RELEASE

Paula Norton
567-4025

August 21, 1980

For Immediate Release:

STRONG INDUSTRIAL APPLICATION FOR NEW AEROSPACE SEALANT WITH
IMPROVED HIGH TEMPERATURE PROPERTIES

Chicago--Extensive development and on-going field testing by the National Aeronautics and Space Administration (NASA) has resulted in an improved fluorocarbon elastomer. This new sealant is thermally and oxidatively stable at temperatures as high as 600°F.

The elastomer would be particularly useful in industrial applications involving seals, gaskets, diaphragms and couplers that encounter elevated temperature and severe vibration.

Additional information on this technology transfer may be obtained from the NASA Manufacturing Applications Team. Contact Mr. Edmund R. Bangs, IIT Research Institute, 10 West 35th Street, Chicago, IL 60616 (312/567-4191).

-END-

Editor's Note: "IIT Research Institute" is our full and proper name--'IIT' initials only.

Enclosure 5.

APPENDIX 1

MATEAM PROGRAM REVIEW
MARSHALL SPACE FLIGHT CENTER
April 30, 1980

IIT RESEARCH INSTITUTE



MANUFACTURING APPLICATIONS TEAM

PROGRAM REVIEW

MARSHALL SPACE FLIGHT CENTER

APRIL 30, 1980

(CONTRACT NAS8-32229 MARSHALL SPACE FLIGHT CENTER, ALA.)



<p>ORGANIZATION</p> <p>II TRI</p>	<p>MARSHALL SPACE FLIGHT CENTER</p> <p>TECHNOLOGY UTILIZATION OFFICE</p>	<p>NAME:</p> <p>A.D.SMITH</p> <p>DATE:</p> <p>APRIL 30, 1980</p>
<ul style="list-style-type: none">0 INTRODUCTION<ul style="list-style-type: none">0 MATEAM PROGRAM OBJECTIVES0 MATEAM CONCENTRATION AREAS0 INDUSTRY AND GOVERNMENT AGENCY COMMUNICATIONS0 INDUSTRY DEMONSTRATIONS0 TECHNOLOGY TRANSFER STATUS - RTOP PROGRAMS0 SUMMARIES<ul style="list-style-type: none">0 PROBLEM STATEMENTS0 APPLICATION PROJECTS AND DIRECT TRANSFER0 ACCOMPLISHMENTS0 MATEAM PLANS		



MANUFACTURING APPLICATIONS

TEAM (MATEAM)

PROGRAM REVIEW

INTRODUCTION

MATEAM PROGRAM OBJECTIVES

- — IDENTIFICATION OF MANUFACTURING ORIENTED PROBLEMS IN THE INDUSTRIAL SECTOR AND GOVERNMENT AGENCIES
- — SCREENING OF NASA TECHNOLOGY FOR POTENTIAL PROBLEM SOLVING TECHNOLOGY
- — DEFINITION OF TRANSFER STRATEGIES, EMPHASIZING APPLICATIONS ENGINEERING PROGRAMS (RTOPS), DIRECT TRANSFERS
- — MAINTAIN CLOSE COMMUNICATION LINK WITH MAJOR INDUSTRIES AND MANUFACTURING ACTIVITIES OF GOVERNMENT AGENCIES

MATEAM CONCENTRATION AREAS

- — **PRODUCTIVITY - ROBOTICS, CAD-CAM**
- — **ENERGY - OIL DRILL RIG MATERIALS PROBLEMS, MOTOR CONTROLS**
- — **SHIPBUILDING—TITANIUM SUBMARINE HULLS, AIRCRAFT CARRIER DECK FABRICATION**
- — **WEAPON SYSTEMS—PRODUCTION DELAYS IN BATTLE TANK MANUFACTURING, DELAYS IN FORGING AND CASTING ORDERS FOR NAVAL AIRCRAFT.**

INDUSTRY AND GOVERNMENT AGENCY COMMUNICATIONS

<u>PRESENTATIONS</u>	<u>TOTAL</u>
INDUSTRY ASSOCIATIONS AND INSTITUTES	22
SELECTED COMPANIES AND CORPORATIONS	21
GOVERNMENT AGENCIES	27
<u>COMPANY VISITS</u>	77
<u>OTHER CONTACTS</u>	
PHONE, MAIL, ETC.	1125

INDUSTRY DEMONSTRATIONS

<u>NASA TECHNOLOGY</u>	<u>LOCATION</u>	<u>ATTENDEES</u>
ROBOTICS	J.P.L.	ROBOT INDUSTRY USERS-MANUFACTURERS
TUBE FLARING SYSTEM	M.S.F.C.	GROTNES MACHINE NAVAL REP.
WELD SKATE	M.S.F.C.	AUTOMOTIVE ROBOT PRESSURE VESSEL WELDING EQUIP.
MAGNETIC HAMMER	MICHOUD	SHIPYARD OFF ROAD EQUIPMENT ALUMINUM ASSOC.
SIALON CUTTING TOOL MTL.	CHICAGO	MACHINE SHOP PERSONNEL
* LASER WIRE STRIPPER	ROCKWELL INT.	ELECTRONICS AIRCRAFT SCRAP WIRE AUTOMOTIVE

* TWO DEMOS IN 1978

TECHNOLOGY TRANSFER STATUS

RTOP PROGRAMS

**TITLE: MAT 246 | AUTOMATIC NON DESTRUCTIVE
FRACTURE TOUGHNESS TESTING (LERC)**

ORIGINATOR: MATEAM —1978 - 1980

**PROBLEM: EXPENSIVE DESTRUCTIVE LABORATORY
TESTING PROCEDURES**

**UNIQUE NASA TECH: PREVIOUS NDT TEST RESULTS AT
LERC**

**INDUSTRIES IMPACTED: SHIPBUILDING, PRESSURE
VESSELS, FABRICATED STRUCTURES**

**BENEFIT: REDUCED FAILURES IN PRESSURE VESSELS,
STRUCTURES AND SHIPS**

POTENTIAL FUNDING SOURCES:

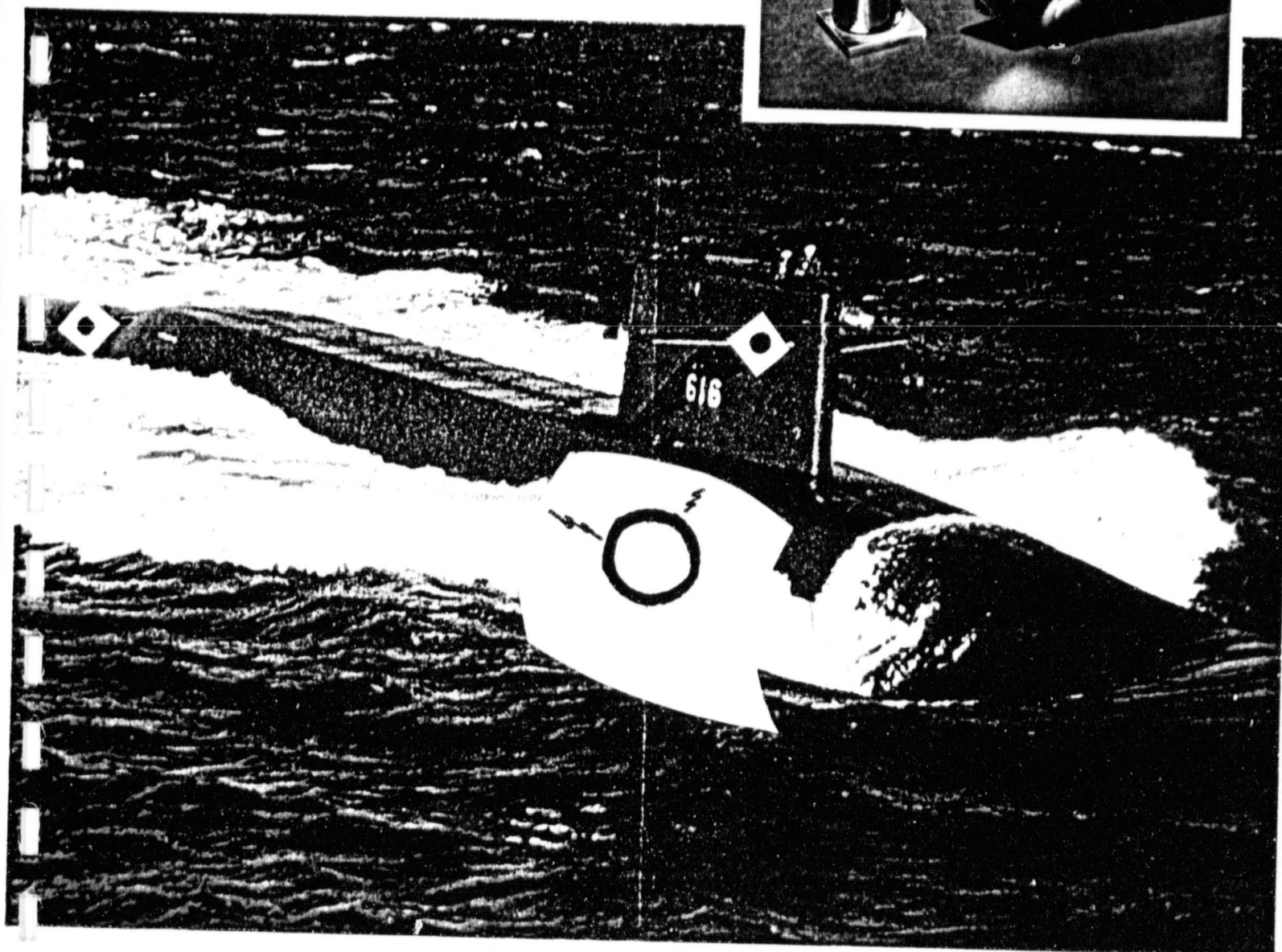
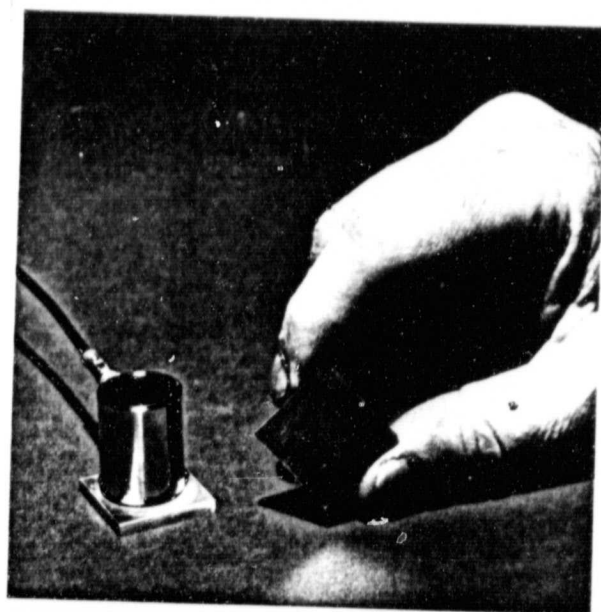
SUN SHIPBUILDING \$25,000 (1978)

NAVAL SHIP R&D CENTER CONSIDERING \$40,000 (1980)

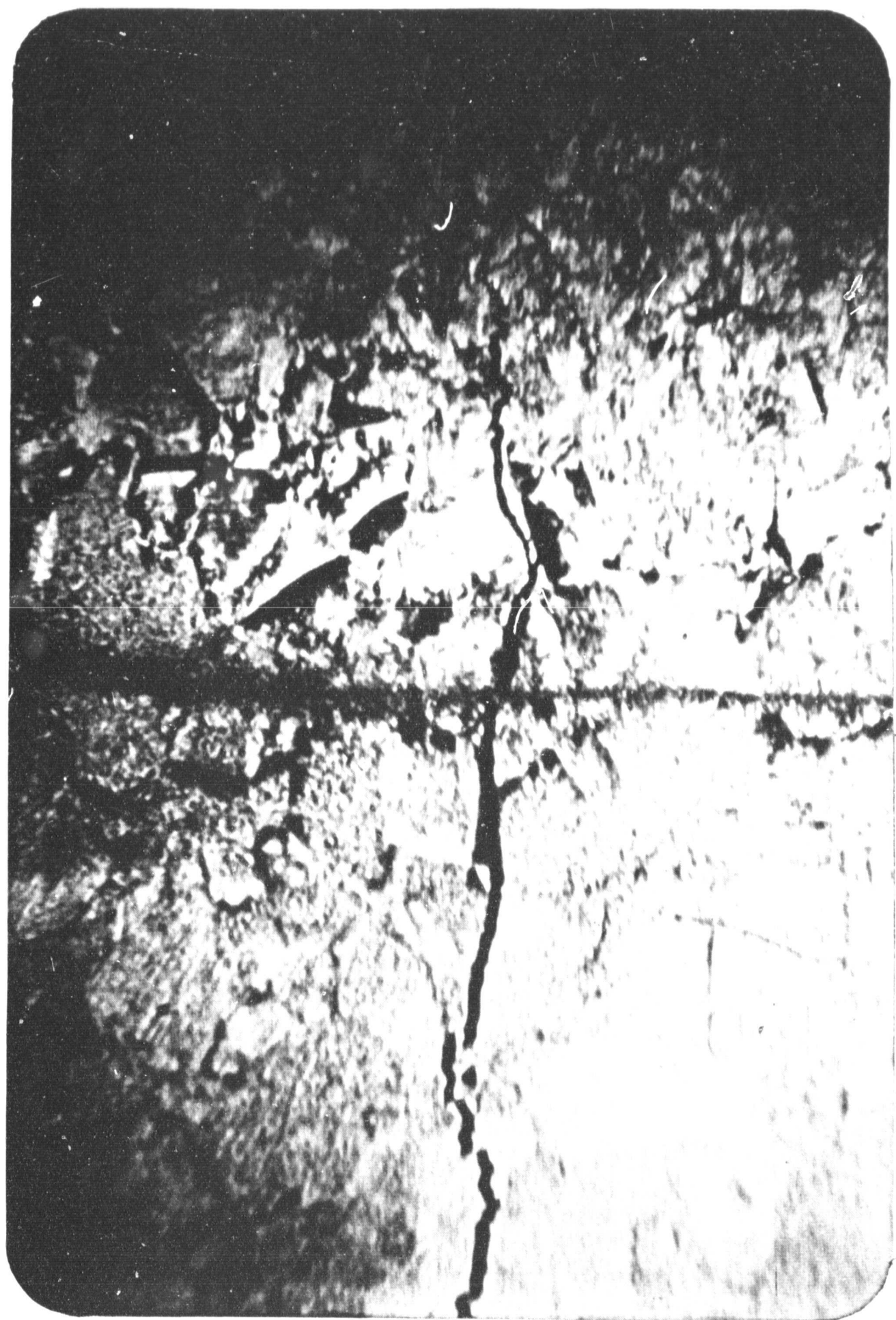
RESISTANCE WELDED TUBING REGAL TUBE CORP. (1980)

**STATUS: SAMPLES BEING MFG FOR LERC TESTING BY
SUNSHIP AND REGAL TUBE**

NRDC PARTICIPATION DECISION APRIL-MAY



ORIGINAL PAGE IS
OF POOR QUALITY



TITLE: MAT 86 AUTOMATED WELDING SYSTEM
"WELD SKATE" (MSFC)

ORIGINATOR: MATEAM 1977—1978

PROBLEM: THE NEED FOR A FULLY AUTOMATED GMA
WELDING SYSTEM WITH TRACKING SYSTEM

UNIQUE NASA TECH: TRACKING SYSTEM AND
COMPUTERIZE TRAVEL

INDUSTRIES IMPACTED: AUTOMOTIVE, SHIPBUILDING,
PRESSURE VESSELS

BENEFIT: IMPROVED PRODUCTIVITY, REDUCED REWORK
COSTS

POTENTIAL FUNDING SOURCES: UNSOLICITED PROPOSAL—
CHEMETRON—CANCELLED (MERGER)
RFP— ARCAIR—CANCELLED REORGAN.
MARITIME ADMIN.—CONSIDERING FUNDING
MERRICK CORP.—EXCLUSIVE LIC.

STATUS: EQUIPMENT BUILDERS NO DEVEL. INVEST.
AWAITING MARITIME ADMIN. FUNDING DECISION
CONSIDERING MERRICK EXCLUSIVE LIC.

**TITLE: MAT 82 AUTOMATED LASER INSPECTION OF
PRINTED CIRCUIT BOARDS (MSFC)**

**ORIGINATOR: MATEAM T.A.I. CORP. HUNTSVILLE, AL
1977—1980**

**PROBLEM: INSPECTION COSTS AND QUALITY WHEN
INSPECTING PRINTED CIRCUIT BOARD SOLDERED
JOINTS**

UNIQUE NASA TECH: LASER LABORATORY TEST DATA

INDUSTRIES IMPACTED: ELECTRONICS

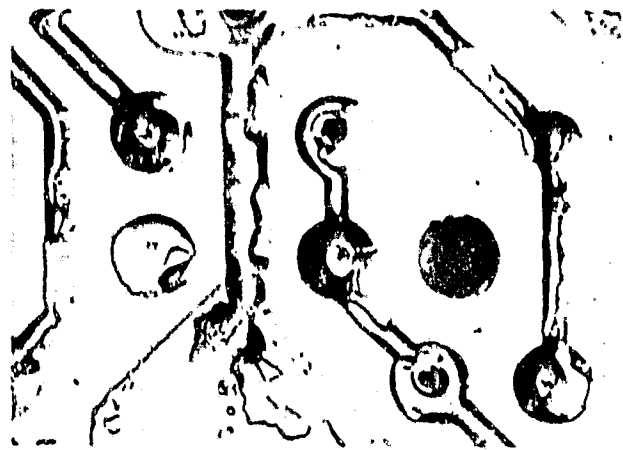
**BENEFIT: REDUCED INSPECTION COSTS WITH AN
IMPROVED INSPECTION TECHNIQUE**

**POTENTIAL FUNDING SOURCES: REDSTONE ARSENAL
MSFC**

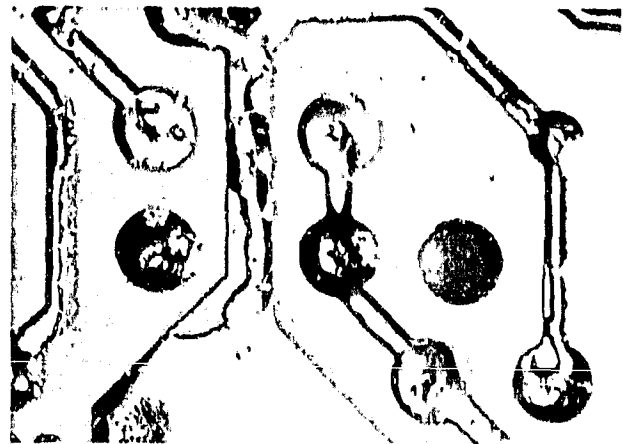
**STATUS: CHRYSLER ELECTRONIC DIV. FUNDED BY
REDSTONE 1978 FURTHER DEVELOPMENT REQUIRED**

Degrees of non-wetting,
etched printed circuit:

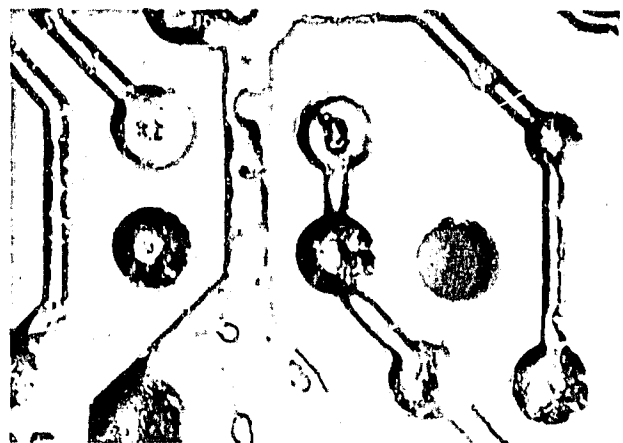
(a) 15 per cent non-wetting



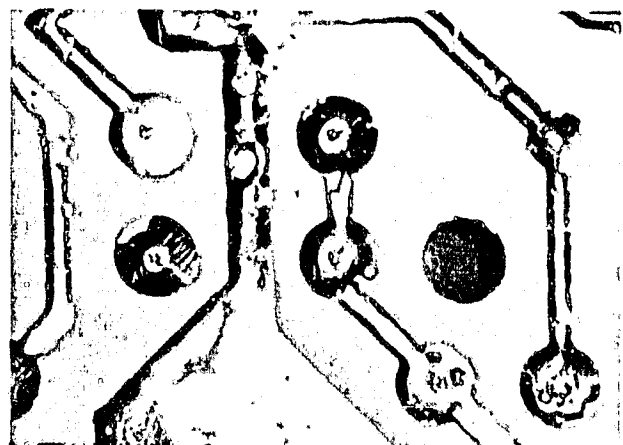
(b) 6 per cent non-wetting



(c) 4 per cent non-wetting



(d) 2 per cent non-wetting



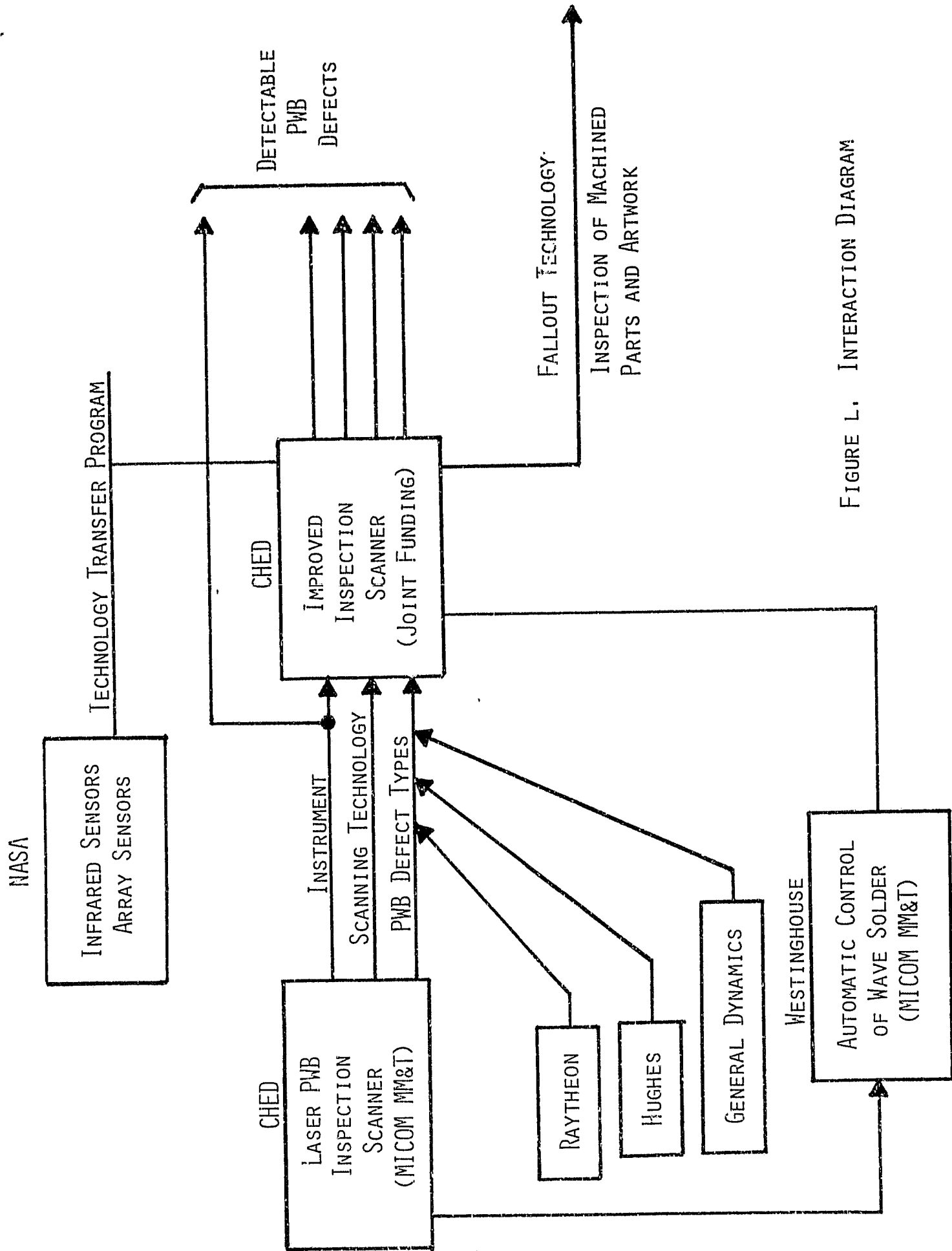


FIGURE L. INTERACTION DIAGRAM

TITLE: MAT 168 ORBITAL TUBE FLARING DEVICE (MSFC)

ORIGINATOR: MATEAM 1978—1980

**PROBLEM: FREQUENT LEAKING IN PRESS FLARED FITTING
CONNECTIONS CRACKING SMALL DIAMETER TUBE**

UNIQUE NASA TECH: ORBITAL TUBE FLARING DESIGN

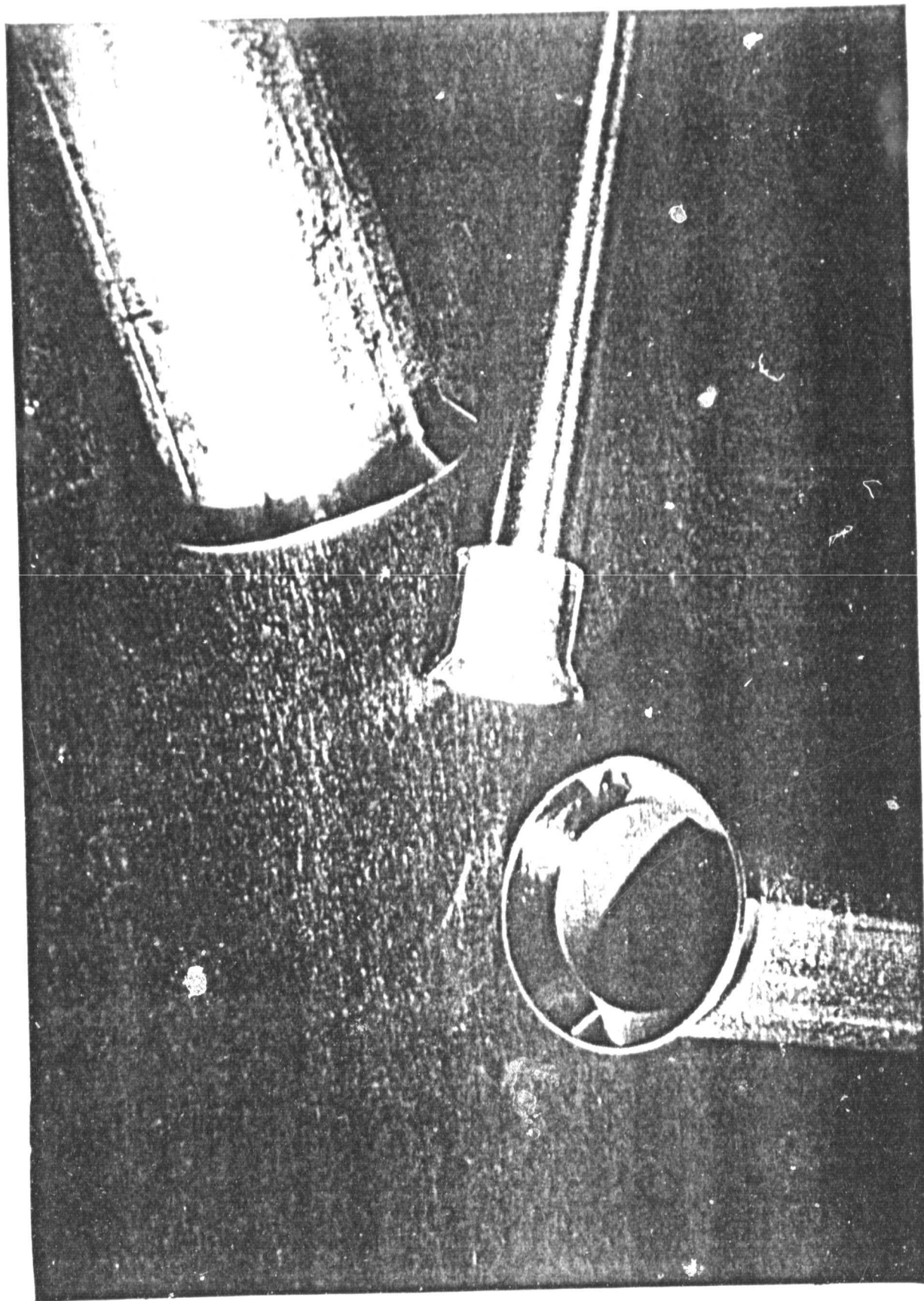
**INDUSTRIES IMPACTED: AUTOMOTIVE, HEAVY EQUIPMENT,
AIRCRAFT**

**BENEFIT: LEAK TIGHT CONNECTIONS, ABILITY TO FLARE
SMALL TUBE**

POTENTIAL FUNDING SOURCES:

NAVAL REWORK FACILITY CALIF.
GROTNES MACHINE WORKS

**STATUS: NAVY REVIEWING MODIFICATION PROPOSAL
GROTNES PERFORMING MARKET ANALYSIS**



Page 12

**TITLE: MAT 175 LASER WIRE INSULATION STRIPPING
SYSTEM (JSFC)**

ORIGINATOR: MATEAM 1978—1980

**PROBLEM: STRIPPING INSULATION FROM MAGNET WIRE
FOR SMALL MOTOR APPLICATIONS (0.002" DIA WIRE)**

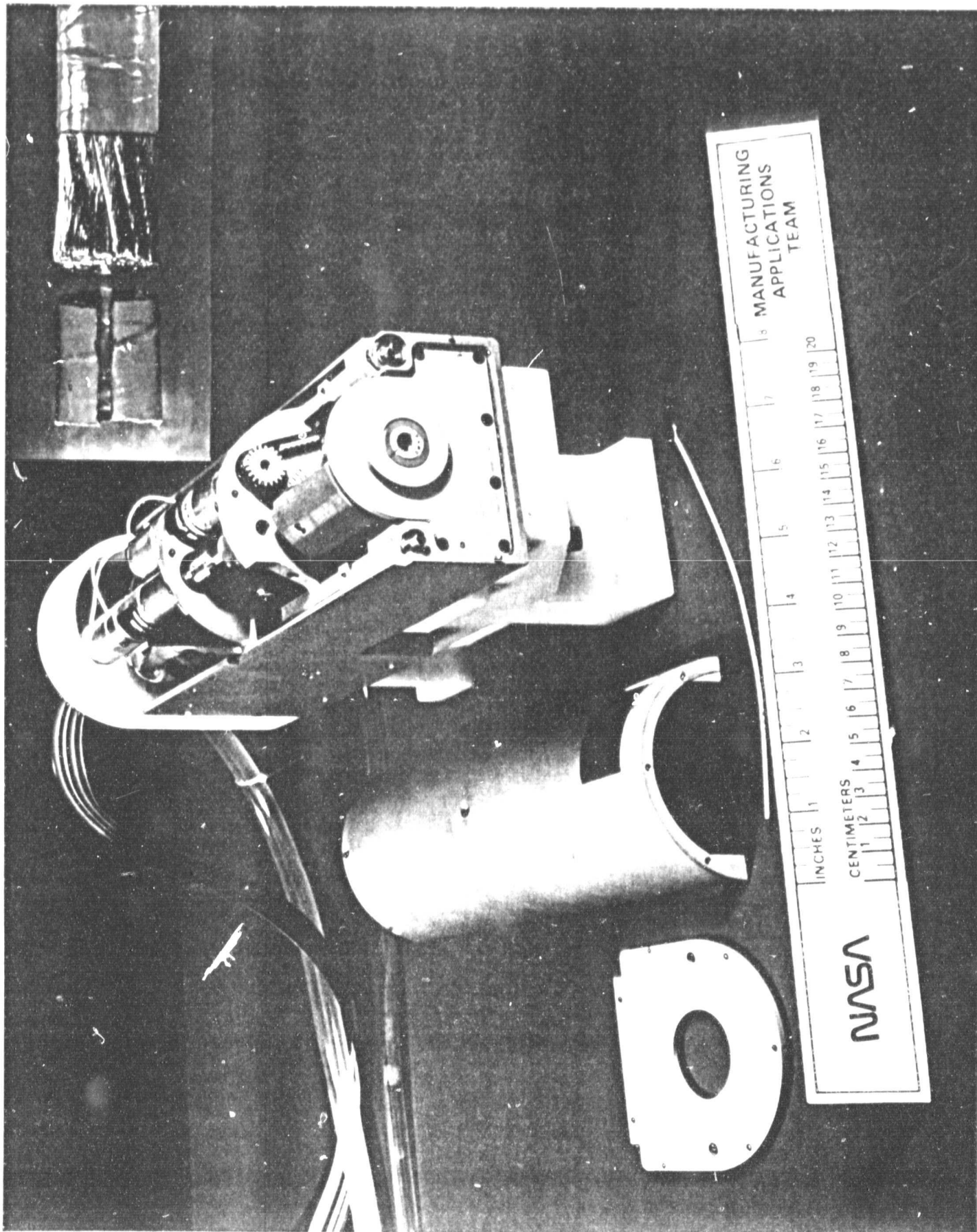
UNIQUE NASA TECH: ROCKWELL INTER SYSTEM

**INDUSTRIES IMPACTED: ELECTRONICS INDUSTRIES,
AIRCRAFT SPECIALTY, CONSUMER, AUTOMOTIVE**

**BENEFIT: IMPROVED PRODUCTIVITY, EXPANDED DESIGN
APPLICATIONS**

**POTENTIAL FUNDING SOURCES: KEARFOTT DIVISION
SINGER CORP**

**STATUS: KEARFOTT ESTABLISHING COST TO MFG MODIFIED
NASA SYSTEM
PROPOSE JOINT FUNDED PROGRAM**



ORIGINAL PAGE IS
OF POOR QUALITY

**TITLE: MAT 294 INFRARED IMAGING GUIDANCE SYSTEM
FOR FUSION WELDING PROCESSES (ARC)**

ORIGINATOR: MATEAM 1980

**PROBLEM: A NON-CONTACTING REAL TIME SENSING
SYSTEM FOR CONTROLLING FUSION WELDING
PROCESSES**

UNIQUE NASA TECH: (ARC) LABORATORY TEST DATA

**INDUSTRIES IMPACTED: AUTOMOTIVE, SHIPBUILDING,
PRESSURE VESSELS**

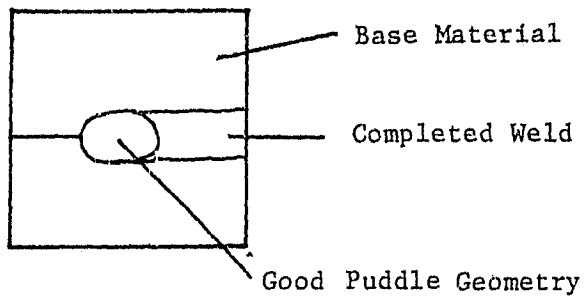
**BENEFIT: IMPROVED PRODUCTIVITY, CONFORMANCE TO
OSHA SAFETY STANDARDS**

**POTENTIAL FUNDING SOURCES: AIRFORCE WPML,
NATIONAL SCIENCE FOUNDATION, ARC**

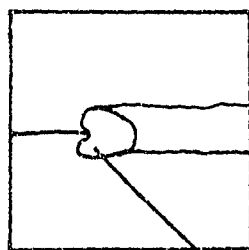
**STATUS: DRAFT RTOP BEING PREPARED FOR REVIEW WITH
GOVT. AGENCIES**

DRAFT DELAYED DUE TO AVAILABLE PERSONNEL

DIAGRAM OF REAL TIME
INFRA RED WELD GEOMETRY
SENSING SYSTEM



A



B

Geometry
Indicating
Poor Fit

Infra Red Image
Sensor and Classifier

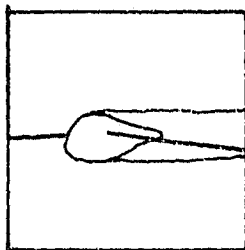
Microprocessor
Control

Welding
Torch

Sensor
Head

Amperage
Voltage
Arc Oscillation
Pulsing
Wire Feed

Welding
Power
Supply



Geometry
Indicating
Excessive
Speed

C

**TITLE: MAT 293 INFRARED SENSOR TECHNOLOGY FOR
ROBOT POSITIONING (J P L)**

ORIGINATOR: MATEAM 1980

**PROBLEM: THE HIGH COST OF TOOLING REQUIRED THE
POSITIONING OF AUTOMOBILE BODIES FOR ROBOT
ASSEMBLY**

UNIQUE NASA TECH: J P L ' DEVEL. OF INFRARED TECH.

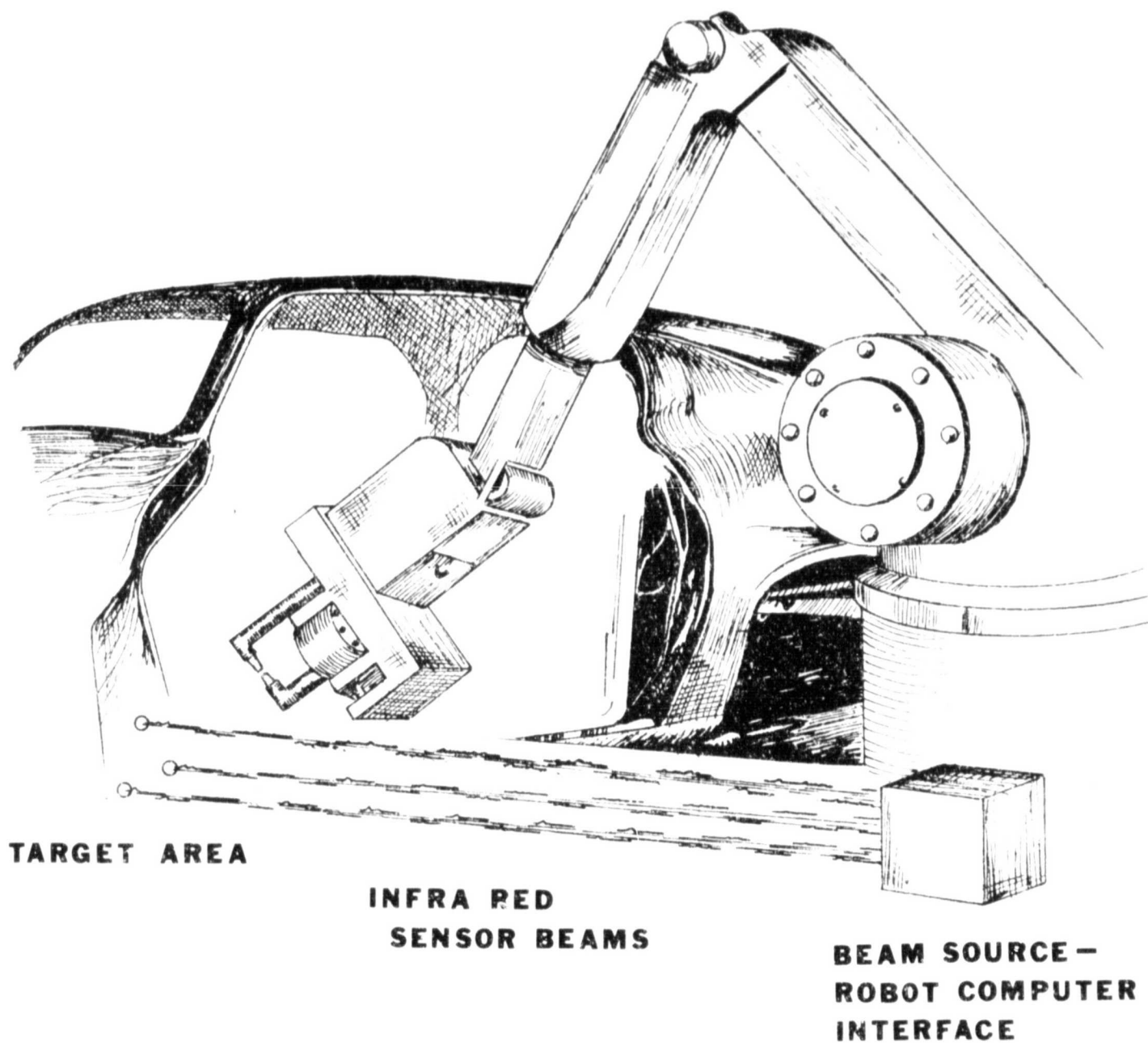
INDUSTRIES IMPACTED: AUTOMOTIVE, STEEL FABRICATION

**BENEFIT: REDUCED TOOLING COSTS AND THE PROTECTION
OF EQUIPMENT IN PRESS OPERATIONS**

**POTENTIAL FUNDING SOURCES: UNIMATION, INC. \$30,000
J P L**

**STATUS: J P L (A. BECZY) PREPARING RTOP PROGRAM
WITH UNIMATION INC.**

NASA INFRARED PROXIMITY DEVICE ESTABLISHING LOCATION
OF WELDMENT IN ACCURATE POSITIONING OF ROBOT FOR WELDING OPERATION



**TITLE: MAT 285, ION BEAM CARBIDE COATING CUTTING
TOOLS (LERC)**

ORIGINATOR: MATEAM

**PROBLEM: EXTENDING CUTTING TOOL LIFE WITH AN ION
BEAM APPLIED CARBIDE COATING**

UNIQUE NASA TECH: LERC ION BEAM TECHNOLOGY

**INDUSTRIES IMPACTED: CUTTING TOOL INDUSTRY, METAL
REMOVAL INDUSTRY, AIRCRAFT TURBINE INDUSTRY**

BENEFIT: REDUCED CUTTING TOOL COSTS

POTENTIAL FUNDING SOURCES: ILLINOIS TOOL WORKS

\$10,000

LERC

**STATUS: NO MANPOWER AVAILABLE FOR COATING TEST
SAMPLES**

**TITLE: MAT 291 BIODIGESTION METHANE GAS GENERATOR
(NSTL)**

ORIGINATOR: MATEAM — NAVY 1980

**PROBLEM: EXCESSIVE AMOUNT OF NATURAL GAS
REQUIRED FOR NAVAL REWORK HEAT TREATING
FACILITY**

**UNIQUE NASA TECH: NSTL WOLVERTON—McDONALD
SYSTEM**

**INDUSTRIES IMPACTED: AIRCRAFT, HEAT TREATING
INDUSTRY**

**BENEFIT: ENERGY SAVING IN REDUCED NATURAL GAS
REQUIREMENTS**

**POTENTIAL FUNDING SOURCES: NAVAL REWORK FACILITY
NORFOLK
NSTL**

**STATUS: W. WOLVERTON PREPARING RTOP PLAN BASED ON
NASA ANEROBIC SYSTEM FOR NAVY REVIEW.**

TITLE: MAT 19 "POWER FACTOR CONTROL SYSTEM"
(MSFC)

ORIGINATOR: MATEAM — ERI 1978 - 1979

PROBLEM: ELECTRICAL POWER REQUIRED
TO OPERATE INDUSTRIAL EQUIPMENT AND
ADDED ADAPTABILITY TO CONTROLLERS
WITH AUTO. POWER FACTOR ADJUST.

UNIQUE NASA TECH: NOLA PATENTED DESIGN

INDUSTRIES IMPACTED: METAL REMOVAL, METAL FORMING

BENEFIT: AUTOMATIC POWER FACTOR ADJUSTMENT
AND REDUCE POWER CONSUMPTION

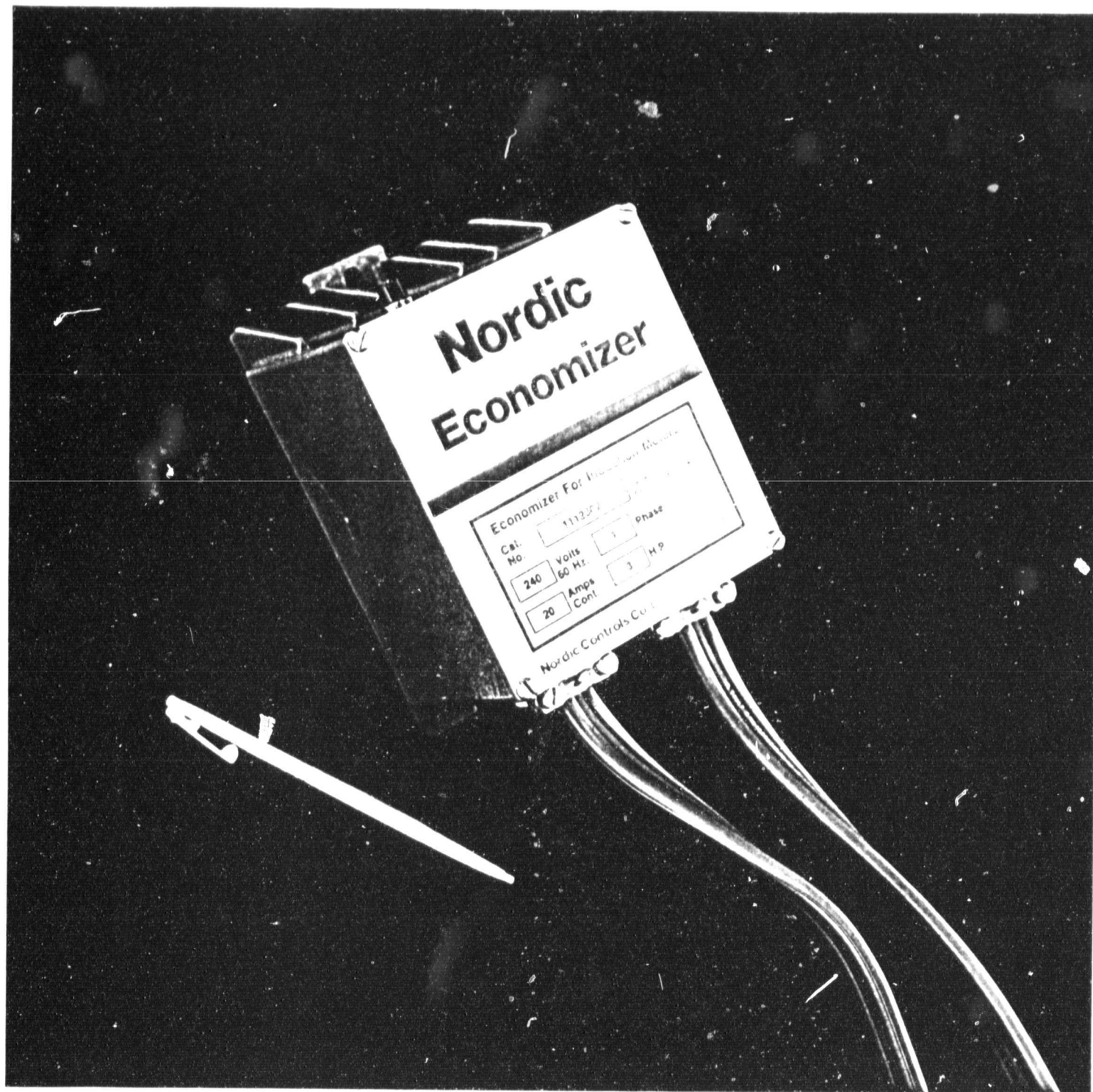
POTENTIAL FUNDING SOURCES:

DOE
MSFC
ERI

STATUS: WIDESPREAD DISSEMINATION UNDERWAY
INITIAL DESIGN

SOURCES - ELECTRONIC RELAYS INC
NORDIC CONTROLS DIV.

FUNDING -- BEING CONSIDERED FOR POWER FACTOR
FEATURE



ORIGINAL PAGE IS
OF POOR QUALITY

**TITLE: MAT 295 PORTABLE SOLAR FOR AGRICULTURAL
APPLICATIONS (MSFC)**

ORIGINATOR: MATEAM 1979

**PROBLEM: NEED FOR ENERGY EFFICIENT HEATING
LIVESTOCK BUILDINGS AND THE DRYING OF GRAIN**

UNIQUE NASA TECH: NASA/IBM SOLAR SYSTEM #4

INDUSTRIES IMPACTED: LIVESTOCK FARMERS

**BENEFIT: HEATING EXISTING BUILDINGS ECONOMICALLY
WITH A MINIMUM OF RENEVATION,
ECONOMICAL METHOD FOR GRAIN DRYING**

POTENTIAL FUNDING SOURCES: DOE

DEPT. OF AGRICULTURE
MSFC

JOHN DEERE

COOK COMPANY—L.C. KOHLMAN

STATUS: PROBLEM SCREENING UNDERWAY

**TITLE: MAT 304 FILLING PROJECTILES WITH EXPLOSIVE
SLURRY (MSFC)**

**ORIGINATOR: ROCK ISLAND ARSENAL 1980
ROCK ISLAND, ILL.**

**PROBLEM: CAVITIES IN DRIED EXPLOSIVES CAUSING
POTENTIAL PREMATURE IGNITION DURING
SHIPMENT AND HANDLING**

UNIQUE NASA TECH: ULTRASONIC TECHNOLOGY

INDUSTRIES IMPACTED: POWDERED METAL

**BENEFIT: NONDESTRUCTIVE DETECTION OF .020"
VOID SPACES IN DRIED EXPLOSIVE POWDER
INSIDE 4" SHELL**

POTENTIAL FUNDING SOURCES: ROCK ISLAND ARSENAL

STATUS: SCREENING PROCESS INITIATED

SUMMARIES

**PROBLEM STATEMENT
SUMMARY
(1977 TO DATE)**

	<u>TOTAL</u>
PROBLEMS IDENTIFIED	301
PROBLEM STATEMENTS PREPARED	292
NASA TECHNOLOGY IDENTIFIED	150
SOLUTIONS ASSESSED	72
SOLUTION STRATEGIES DEVELOPED	37

PROBLEM STATEMENT CATEGORIES

• COMPUTER AIDED SYSTEMS (COST/BENEFIT, ANALYSIS, DESIGN , MANUFACTURING)	27
• RAW MATERIALS	55
• MACHINING AND/OR FORMING	32
• JOINING PROCESSES (WELD, GLUE, RIVET, ETC.)	26
• SURFACE TREATMENT (CLEANING, CONFORMAL COATING, SURFACE COATING)	28
• INSPECTION METHODS AND INSTRUMENTS	52
• ASSEMBLY PROCESSES AND EQUIPMENT (ROBOTS, FIXTURES, ETC.)	19
• MAINTENANCE (LUBRICATION, VIBRATION ANALYSIS, ETC.)	7
• ENERGY RELATED	9
• ENVIRONMENT (NOISE, HEAT, TOXIC SUBSTANCES, ETC.)	18
• MISCELLANEOUS	28

PROBLEM STATEMENT STATUS

TOTAL PROBLEM STATEMENTS PROGRAM TO DATE	301
---	------------

PROBLEM STATEMENTS DELETED PROGRAM TO DATE	113
---	------------

TOTAL ACTIVE PROBLEM STATEMENTS	188
--	------------

**APPLICATION PROJECTS
AND DIRECT TRANSFERS
SUMMARY
(1977—1979)**

1977 - ORIENTATION YEAR

1978

APPLICATION PROJECTS STARTED

RTOP PROGRAMS

- A-C INDUCTION MOTOR CONTROL (MSFC)
- AUTO. WELDING SYSTEM - WELD SKATE (MSFC)
- AUTO. NDT FOR FRACTURE TOUGHNESS (LERC)

INDUSTRY FUNDED PROGRAMS

- ALUM. STUD WELDING FLUX (MSFC)
- LASER WIRE INSULATION STRIPPING (JSC)
- ADAMS MANIPULATOR ARM (MSFC)
- LIXISCOPE (GSFC)

RFP

- A-C INDUCTION MOTOR CONTROL (MSFC)

1978(CONTD)

IMPLEMENTATIONS INITIATED

APPLICATIONS PROJECTS COMPLETED

- ALUM. STUD WELDING FLUX (MSFC)**
- LASER WIRE INSULATION STRIPPING (JSC)**
- ADAMS MANIPULATOR ARM (MSFC)**

DIRECT TRANSFERS

- SOLDER TECHNOLOGY (MSFC)**
- CUTTING TOOL (JPL)**
- SOLAR CELL COATING (LERC)**
- TORQUE MEAS. (LAR)**
- LIXISCOPE (GSFC)**

57

APPLICATION DEVELOPMENT

RFP PROGRAMS

- ADAMS MANIPULATOR ARM, PLANT "A" (MAY)
- COORDINATION OF THE MANIPULATOR ARM WITH THE
MAY
- ADAMS MANIPULATOR ARM, PLANT "B" (MAY)
- COORDINATION OF THE MANIPULATOR ARM WITH THE
MAY
- PORTABLE PLANT HEATING SYSTEM FOR
AGRICULTURAL APPLICATIONS (MAY)

INDUSTRY FUNDED PROGRAMS

- ADAMS MANIPULATOR ARM, PLANT "A" (MAY)
- BOLT TENSION MONITOR (JAN)
- A-C INDUCTION CONTROL (MODIFIED DEERIN) (MAY)

RFP PROGRAMS — NONE

1979 (CONTD)

IMPLEMENTATIONS INITIATED

APPLICATION PROJECTS COMPLETED — NONE

DIRECT TRANSFERS

- WIRE SELECTOR CALCULATOR (JRC)
- ADVANCED BEARING FAILURE DETECTOR (MSFC)
- MAGNETIC HAMMER COIL (MSFC)

ACCOMPLISHMENT SUMMARY

APPLICATION PROJECTS STARTED (19)

—RTOP PROGRAMS (11)

- A-C INDUCTION MOTOR CONTROL (MSFC) - ERI**
- AUTO WELDING SYSTEM - WELD SKATE (MSFC) -
CHEMETRON**
- AUTO NDT FOR FRACTURE TOUGHNESS (LeRC) -
SUN SHIP**
- LASER MAGNET WIRE INSULATION STRIPPING
(JSFC) - RAYTHEON**
- BIODIGESTION SYSTEM METHANE GAS GENERATOR
(NSTL) - NAVY REWORK FACILITY**
- NDT FRACTURE TOUGHNESS TESTING TITANIUM
(LeRC) - NSRDC**
- INFRARED ROBOT POSITIONING (JPL) - UNIMATION, INC.**
- INFRARED IMAGING FOR FUSION WELDING (ARC) -
AIR FORCE**
- ION BEAM COATING CUTTING TOOLS (LeRC) - ITW**
- ORBITAL TUBE FLARING (MSFC) - GROTNES/NAVY**
- PORTABLE SOLAR HEATING SYSTEM FOR
AGRICULTURAL APPLICATIONS (MSFC) - COOK CO./DOE**

ACCOMPLISHMENT SUMMARY (CONTD)

APPLICATION PROJECTS STARTED (CONTD)

—INDUSTRY FUNDED PROGRAMS (7)

- ALUM. STUD WELDING FLUX (MSFC) - TRUFIT PRODUCTS**
- LASER WIRE INSULATION STRIPPING (JSC) - RATHEYON**
- ADAMS MANIPULATOR ARM (MSFC) - VIM SYSTEMS**
- LIXISCOPE (GSFC) - NITEC**
- ADAMS MANIPULATOR ARM (PHASE II) (MSFC) VIM SYSTEMS**
- BOLT TENSION MONITOR (LAR) - XYTEL**
- A-C INDUCTION CONTROL (MODIFIED DESIGN) (MFSC) NORDIC CONTROLS DIVISION (FURNAS)**

—RFP PROGRAMS (1)

- A-C INDUCTION MOTOR CONTROL (MSFC) - ERI**

ACCOMPLISHMENT SUMMARY (CONTD)

IMPLEMENTATIONS INITIATED (11)

—APPLICATION PROJECTS COMPLETED (3)

- ALUMINUM STUD WELDING FLUX (MSFC) - TRUE FIT**
- LASER WIRE INSULATION STRIPPING (JSC) - RAYTHEON**
- ADAMS MANIPULATOR ARM (MSFC) - VIM SYSTEMS**

—DIRECT TRANSFERS (8)

- SOLDER TECHNOLOGY (MSFC) - BORG-WARNER**
- CUTTING TOOL (JPL) - ACCURATE TOOL**
- SOLAR CELL COATING (LERC) - UNIVERSITY OF ILLINOIS**
- TORQUE MEASURING DEVICE (LAR) - G.M.**
- LIXISCOPE (GSFC) - ERI**
- WIRE SELECTOR CALCULATOR (JSC) - ERI**
- ADVANCE BEARING FAILURE DETECTOR (MSFC) - ENDEVCO**
- MAGNETIC HAMMER COIL (MSFC) MAXWELL IND.**

**APPLICATION PROJECTS
AND DIRECT TRANSFERS
SUMMARY
(1977—1979)**

	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>TOTAL</u>
<u>APPLICATION PROJECTS</u>				
<u>STARTED:</u>				
—RTOP PROGRAMS	—	3	8	11
—INDUSTRY FUNDED PROGRAMS	—	4	3	7
—RFP PROGRAMS	—	<u>1</u>	<u>0</u>	<u>1</u>
 TOTAL APPLICATION PROJECTS STARTED	 —	 <u>8</u>	 <u>11</u>	 <u>19</u>
 <u>IMPLEMENTATIONS</u>				
<u>INITIATED</u>				
—APPLICATION PROJECTS COMPLETED	—	3	0	3
—DIRECT TRANSFERS	—	<u>5</u>	<u>3</u>	<u>8</u>
 TOTAL IMPLEMENTATIONS INITIATED	 —	 <u>8</u>	 <u>3</u>	 <u>11</u>

MATEAM PLANS

MATEAM PLANS

OPERATIONAL FACTORS AND IMAGE

- CONTINUE PRESENT MODE OF OPERATION
- STRENGTHEN COMMUNICATIONS GOVERNMENTAL AGENCIES AND INDUSTRY ASSOCIATIONS
- MATEAM PAST PEAK LEARNING CURVE
- TEAM FULLY FUNCTIONAL-EXPERIENCED PERSONNEL
- IITRI RECOGNIZED AT ALL FIELD CENTERS AS MATEAM
- WHAT HAVE WE LEARNED
 - TRANSFER MECHANISM REQUIRES PERSONNEL CONTACT
 - MARGINAL RESPONSE FROM GROUP BRIEFINGS
 - GOVERNMENT AGENCIES AND ASSOC. NOT AWARE OF PROBLEMS

CURRENT ACTIVITIES

CONCENTRATE ON

- ROBOT SENSOR TECHNOLOGY
- CAD/CAM-AIR FORCE-NAVY-COMPUTER AIDED CASTING MOLD DESIGN
- SCRAP WIRE INDUSTRY - LASER
- ARMY ULTRASONIC INSPECTION (PCB'S)

APPENDIX 2

MATEAM BROCHURE

TECHNOLOGY TRANSFER



**SOLVING MANUFACTURING PROBLEMS
THROUGH AEROSPACE TECHNOLOGY**



MANUFACTURING APPLICATIONS TEAM

IIT Research Institute 10 West 35th Street Chicago, Illinois 60616 312/567-4191



(CONTRACT NAS8-32229 MARSHALL SPACE FLIGHT CENTER, ALA.)

SUMMARY

The objective of the Manufacturing Applications Team (MATeam) is to identify manufacturing problems through communication with industry and to transfer National Aeronautics and Space Administration Technology without charge to the manufacturer. The MATeam consists of technical personnel at the IIT Research Institute who work with professional societies, industry associations and individual companies to define wide-spread manufacturing problems and identify potential solutions utilizing aerospace technology. In addition to identifying and screening appropriate technologies, the team, in cooperation with NASA, industrial organizations, or other government agencies, demonstrates solutions by conducting application engineering work. The MATeam is sponsored by NASA as part of its Technology Utilization Program which is aimed at increasing the nation's return on investment in aerospace research by assuring that the benefits of this technology are made available to all sectors of the economy. Inquiries pertaining to the team, its goals or objectives may be directed to:

MR. EDMUND R. BANGS
IIT RESEARCH INSTITUTE
10 WEST 35TH STREET
CHICAGO, ILLINOIS 60616
(312) 567-4191

IIT RESEARCH INSTITUTE

OBJECTIVES

The objective of the MATeam is to successfully transfer aerospace technology to solve key problems in the manufacturing sector of the economy. The underlying purpose for the team is to increase the return on the nation's investment in aerospace research by fostering wide implementation and use of NASA technology and expertise. The function of the team in accomplishing this objective is to provide an important intermediary role between technology sources and technology users in order to: improve the communication process; assist in the movement of new technology across organizational and disciplinary boundaries; shorten the time between technological development and its broad and effective implementation in the Industrial Sector.

NASA's decision to sponsor an applications team to effect technology transfer in manufacturing was both timely and appropriate. The United States, while still ahead of other industrialized nations in terms of overall manufacturing capabilities, and state of technology, is finding its leadership position diminishing. The productivity problem is becoming increasingly severe because of the continual rise in the cost of energy, raw material and labor and the need to maintain our competitive position in the world market. Clearly, a way for your company to combat this growing national problem and maintain a competitive advantage is to capitalize upon and speed up adaptation of new manufacturing technologies. Participation in the NASA Technology Utilization Program with the IITRI Manufacturing Applications Team will provide the vital link with unique Aerospace Manufacturing Technology.

IIT RESEARCH INSTITUTE

PROGRAM APPROACH

Achieving significant technology transfer, widespread implementation, usage of new products, and processes is not something that occurs quickly. To bring about successful technology transfer, industry problem areas, or market needs, must be matched with solutions that are both technically sound and economically feasible. This matching of needs with solutions does not, however, guarantee technology transfer; it is also necessary to establish effective means for commercializing the new product or process. Thus the MATEam's task is somewhat analogous to that of identifying and implementing new business opportunities and carries with it the many pitfalls normally associated with new venture development groups.

The approach used by the MATEam is structured to insure that the team's efforts are focused on bringing about successful technology transfer and that common pitfalls are avoided. Key elements of the approach are described below.

INDUSTRY INTERACTION

Effective communication channels between the team, industry associations, individual companies, NASA personnel and other government agencies is necessary to coordinate the team's efforts throughout all phases of the technology transfer process, from identification of technology opportunities to commercialization and implementation of new processes and equipment. The MATEam provides this interaction through numerous presentations to industry groups, visits to companies for in-plant discussion of problems and potential solutions, and extensive consultation by phone and mail. To help foster this type of interaction, there is no fee charged to industry for the team's services.

IIT RESEARCH INSTITUTE

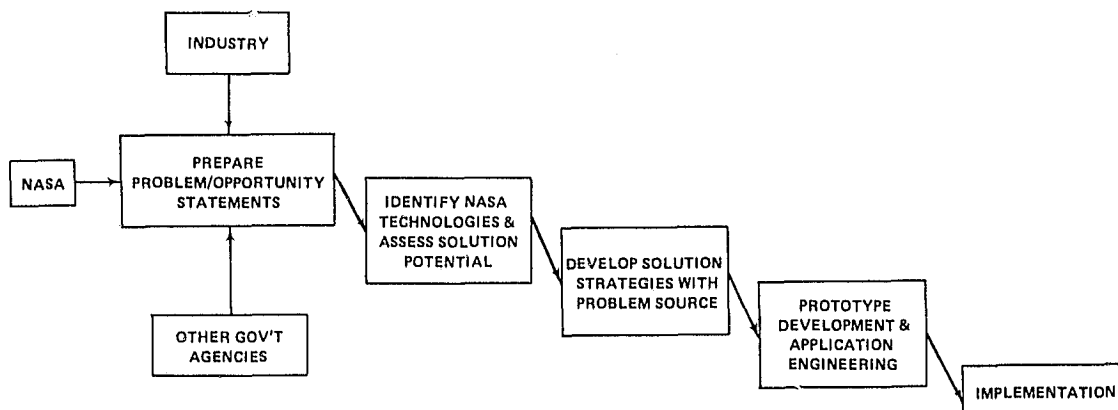
MATEAM TECHNOLOGY TRANSFER PROCESS

There are two basic approaches which are used to effect technology transfer:

1) to use the technology available as a basis for initiating the transfer process and then seek out applications for that technology, or 2) to begin the transfer process by identifying the technology needs of the target industry sector and then determine if relevant technology is available to satisfy those needs.

Starting the technology transfer process with identification of industry needs rather than the aerospace technology available provides several distinct advantages. First, it helps insure that the team is responsive to the needs of industry. Second, it provides a ready market for the aerospace technology if it can be found, thus helping to insure rapid commercialization and implementation. Additionally, by documenting the technology opportunities and circulating them to appropriate NASA personnel, the effectiveness of the search for relevant technology is increased and, in some cases, may even result in innovative solution to problems because of the unique technical expertise of NASA personnel. Last, starting with industry problems rather than the available technology helps insure that the team's effort are spent on areas of greatest need and payback and not in trying to bring about solutions for which there is no real problem.

A diagram of the MATEam technology transfer screening process is shown below. It represents a logical sequence of steps, beginning with the identification and documentation of industry technology opportunities, or problem areas, and ending in successful technology transfer.



IIT RESEARCH INSTITUTE

The MATEam identifies manufacturing problems, or technology opportunities. Once identified, problems are documented in the form of problem statements, which are used by the MATEam throughout the technology transfer process. Problem statements play a key role in the MATEam's activities. They serve as a means of communicating information about the problem to team members and NASA scientists and engineers in an effort to:

- Seek out potential solutions
- Evaluate the likelihood of successfully solving a problem and implementing a solution, and
- Compare problems and concentrate on those which have the highest likelihood of solution and potential benefit.

In addition to its internal use, the MATEam circulates edited copies of the problem statements to technical personnel in the NASA field centers and laboratories. This helps insure that every effort is made to identify appropriate technology if it exists. The problem statements are edited prior to circulation to NASA personnel to reserve the name of the problem originator and any information of a proprietary nature.

Copies of the problem statement are not circulated outside of NASA or the MATEam until a potential solution has been identified. If a potential solution has been identified, other organizations may be contacted to assess the magnitude of the problem and the suitability of the potential solution. Unedited problem statements are not circulated under any circumstances.

Problems which the MATEam will work on must meet three criteria:

- The problem must be manufacturing related.
- The problem must apply to more than one company.
- Solutions to problems must be based on NASA technology.

The problem statements are screened at several stages during the technology transfer process. The questions asked during the screening are:

- Do satisfactory commercial solutions already exist for this problem?
- What is the likelihood of identifying relevant NASA technology?
- What is the magnitude of the benefits to be gained by solving the problem?
- Can the problem be solved technically?
- Can a solution be implemented?

The answers to these questions are used to select those problems which the MATeam can most effectively solve. In those instances where a problem statement does not pass the screening process, the problem originator is notified and told the reason for the decision.

Those problem statements which survive the preliminary screening (i.e., are deemed suitable for the team) then enter the next phase of the technology transfer process: identification of relevant NASA technology which would provide wholly or in part, a solution. This is accomplished through data and literature searches utilizing NASA's Scientific and Technical Information Facility, annual STAR indices, review of NASA Tech Briefs and by contacting individual NASA personnel with the necessary expertise for further discussions of the technology involved.

Following the identification of relevant NASA technology, each potential solution is given a more in-depth analysis. The solutions are assessed in terms of impact of solving the problem, likelihood of successful solution and implementation, resources required to effect commercialization and organizations which should be involved.

If the solution still appears valid after this assessment, the team then develops an implementation strategy to bring about commercialization. Such factors as applications engineering and implementation costs and the proper time phasing of the implementation are taken into consideration when developing the implementation strategies. Inputs from the problem originator and NASA personnel are solicited in devising these strategies. The particular implementation strategy that is developed will depend on the individual case in point, but in general, the strategy will be one of the following types:

- Direct transfer of the solution information and immediate implementation by the user.
- Applications engineering followed by test and implementation totally funded by the user or someone in a position to commercialize the process or product.
- Applications engineering jointly funded by the user/commercializer and NASA with subsequent test and implementation by the user/commercializer.

Once an implementation strategy is agreed upon between the MATeam, NASA, the problem originator and a commercializer, implementation is initiated. Successful technology transfer and implementation takes varying amounts of time to come to fruition, depending on the specific case. Some occur rapidly, while others will take more time because of applications engineering and the type of industry and technology involved.

In order to achieve the maximum possible implementation, the team widely disseminates news pertaining to successful technology transfers. This dissemination of information is accomplished through press releases and articles in appropriate trade journals, magazines, etc., and presentations at conferences and other meetings.

JOINT FUNDED APPLICATIONS ENGINEERING PROGRAMS

Frequently technology in the final stages of transfer will require modifications in order that it might be more competitive under existing market conditions, or can more accurately solve a manufacturing oriented problem.

Joint funding can consist of NASA and one or more other Federal Agencies, a Technical Society, and the User or Marketing Source. The industrial participants (example: User, Marketing Source), may provide their facilities and manpower as their dollar equivalent funding share rather than a cash outlay.

TYPICAL QUESTIONS PERTAINING TO MATEAM ACTIVITIES

What types of technology are available? The areas in which NASA has conducted research are almost limitless. Their technology data base contains over 7 million documents and includes not only the results of their research but also that of other government agencies and private sources. Just a few of the areas in which NASA has been active are:

- Powder Metallurgy
- Robotics
- Clean Room Technology
- Metal Joining
- Organic and Inorganic Coatings
- Metal Forming
- Composite Materials
- Nondestructive Testing
- High Velocity Metalworking
- Fluidotics
- Superalloys
- Instrumentation
- Plasma Jet Technology
- Adhesives
- Control Systems
- Computer Applications
- Material Handling
- Optics
- Lasers
- Seals
- Fasteners
- Sputtering and Ion Plating
- Fracture Mechanics
- Management Techniques
- Plastics
- Cryogenics
- Hazardous Materials
- Lubricants
- Ceramics
- Acoustic Technology
- Plating
- Shock and Vibration Technology
- Human Factors Engineering
- Energy
- Microelectronics
- Sensors
- Measurement Technology
- Vacuum Technology
- Packaging and Container Technology
- Tooling and Fixtures
- Safety and Maintenance Engineering
- Insulation
- Casting Techniques
- Quality Control

What types of problems does the MATEam work on? The team will consider any problem — — materials, processes, equipment, management techniques, etc., — — which impacts manufacturing productivity. However, the problems must apply to more than one company and the solutions must be based on NASA technology.

What does it cost to participate in the MATEam Program? The MATEam is sponsored by NASA and there is no charge to participating industrial organizations or companies for the team's services.

Who pays for applications engineering? The MATEam has some funding for minor applications engineering efforts. Additional Applications engineering may be funded wholly or in part by industry associations, individual companies, NASA and other government agencies. NASA encourages joint funded development programs with industry in the transfer of NASA Technology with significant impact.

What happens if my problem is not found suitable for further assistance from the team? Occasionally problems do not pass the initial MATEam screening because commercially available solutions already exist, they only apply to one company, or relevant NASA technology cannot be identified. In these cases, the problem originator is notified and is furnished with any pertinent information the team may have on the subject.

The MATEam is sponsored by NASA's Marshall Space Flight Center. Does this mean that the MATEam will only consider NASA technology at that center? No. The team has access to personnel and technology at all of the NASA centers.

Who owns the rights to the technology? Many of NASA's innovations are not patented and are available to anyone. In those cases where a NASA patent is involved, NASA may grant non-exclusive and exclusive licenses.

What's expected from me? We only ask that if we are able to assist you in solving a problem, then we be allowed to publicize that solution so that others may also benefit. Some organizations may participate more heavily in the program by preparing problem statements, assisting in evaluating potential solutions and conducting applications engineering.

How does the MATEam handle proprietary information? When brought to the team's attention, proprietary information will be held in the strictest confidence and will not be circulated outside of the team. Team members will also sign non-disclosure statements if requested to do so.

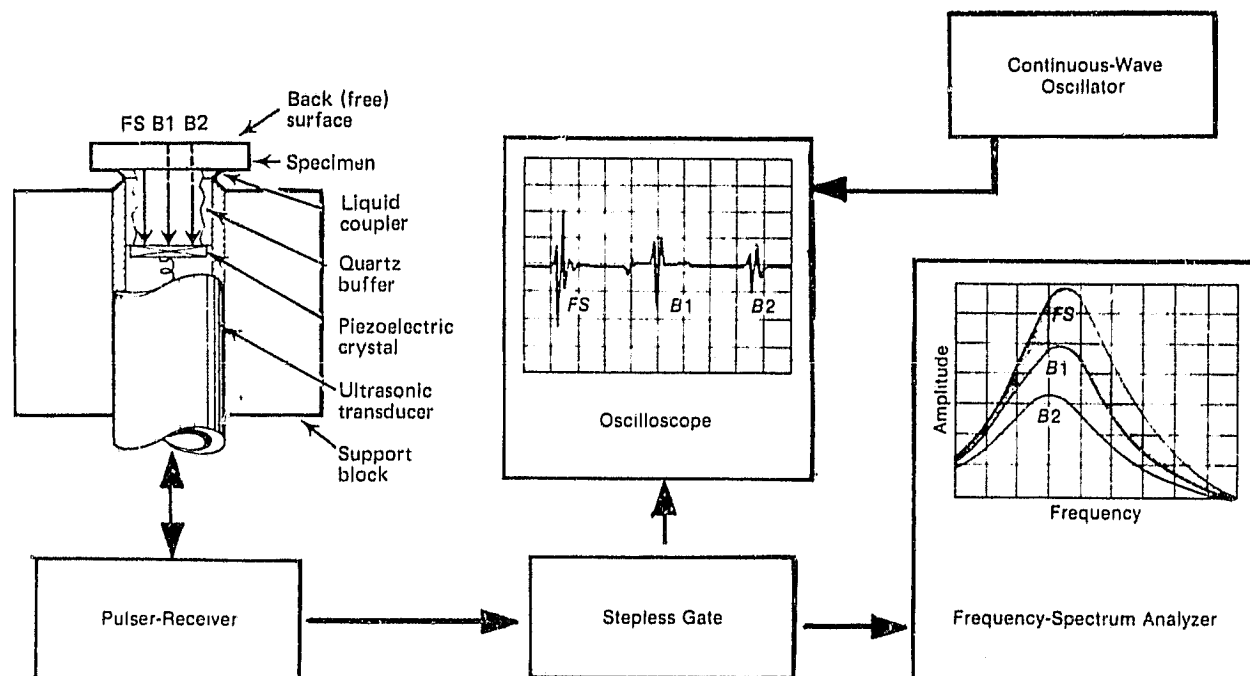
How long does it take to get a response from the team on my problem? Although this varies depending on the problem and the team's day-to-day workload, our goal is to complete initial screening of the problem within 30 days. Actual solutions may take several months or longer if applications engineering is required.

The IIT Research Institute is a not-for-profit scientific and engineering research organization working for the advancement of knowledge and the beneficial applications of science and technology to meet the needs of society. It provides a scientific and engineering capability and physical environment which allows it to contribute to the technological advancement of industry and government and of its own staff. IITRI provides the resources and the mechanisms to apply a broad spectrum of scientific and engineering capabilities to the solution of problems important to the national interest.

IIT RESEARCH INSTITUTE

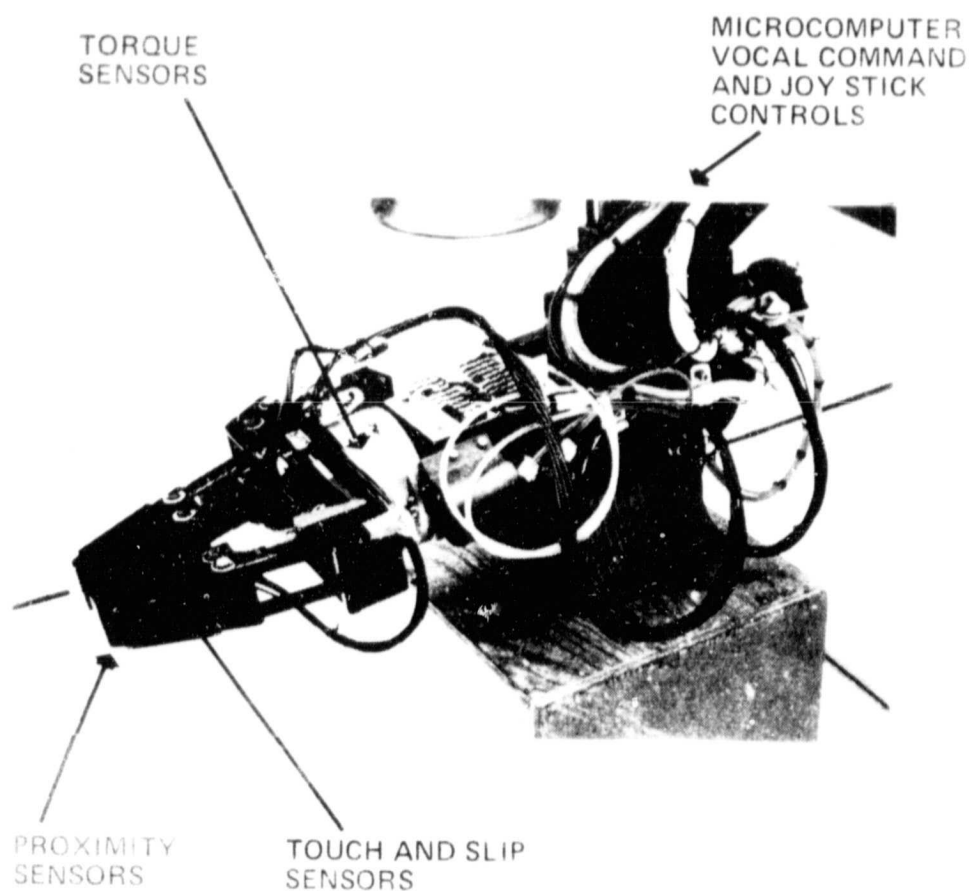
THE FOLLOWING PAGES ILLUSTRATE SOME
TECHNOLOGIES IN COURSE OF TRANSFER

ANALYZING THE ECHOES



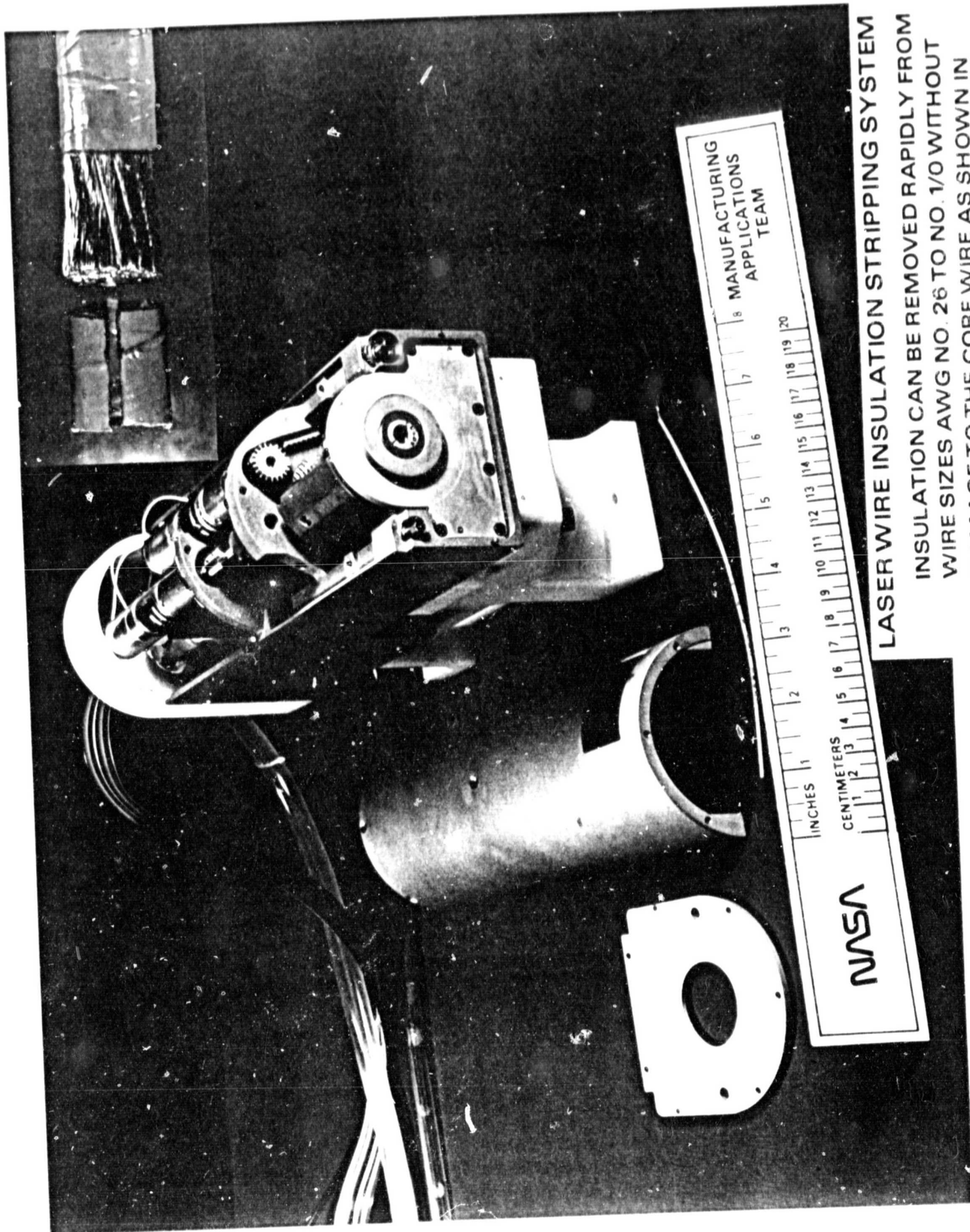
NONDESTRUCTIVE FRACTURE TOUGHNESS TESTING

ULTRASONIC SIGNAL MONITORING SHOWS CORRELATION
BETWEEN SIGNAL SPEED AND K_{1C} TOUGHNESS VALUES.



ROBOT SENSOR TECHNOLOGY

ORIGINAL PAGE IS
OF POOR QUALITY



MANUFACTURING
APPLICATIONS
TEAM

LASER WIRE INSULATION STRIPPING SYSTEM

INSULATION CAN BE REMOVED RAPIDLY FROM
WIRE SIZES AWG NO. 26 TO NO. 1/0 WITHOUT
DAMAGE TO THE CORE WIRE AS SHOWN IN
COMPOSITE DRAWING.

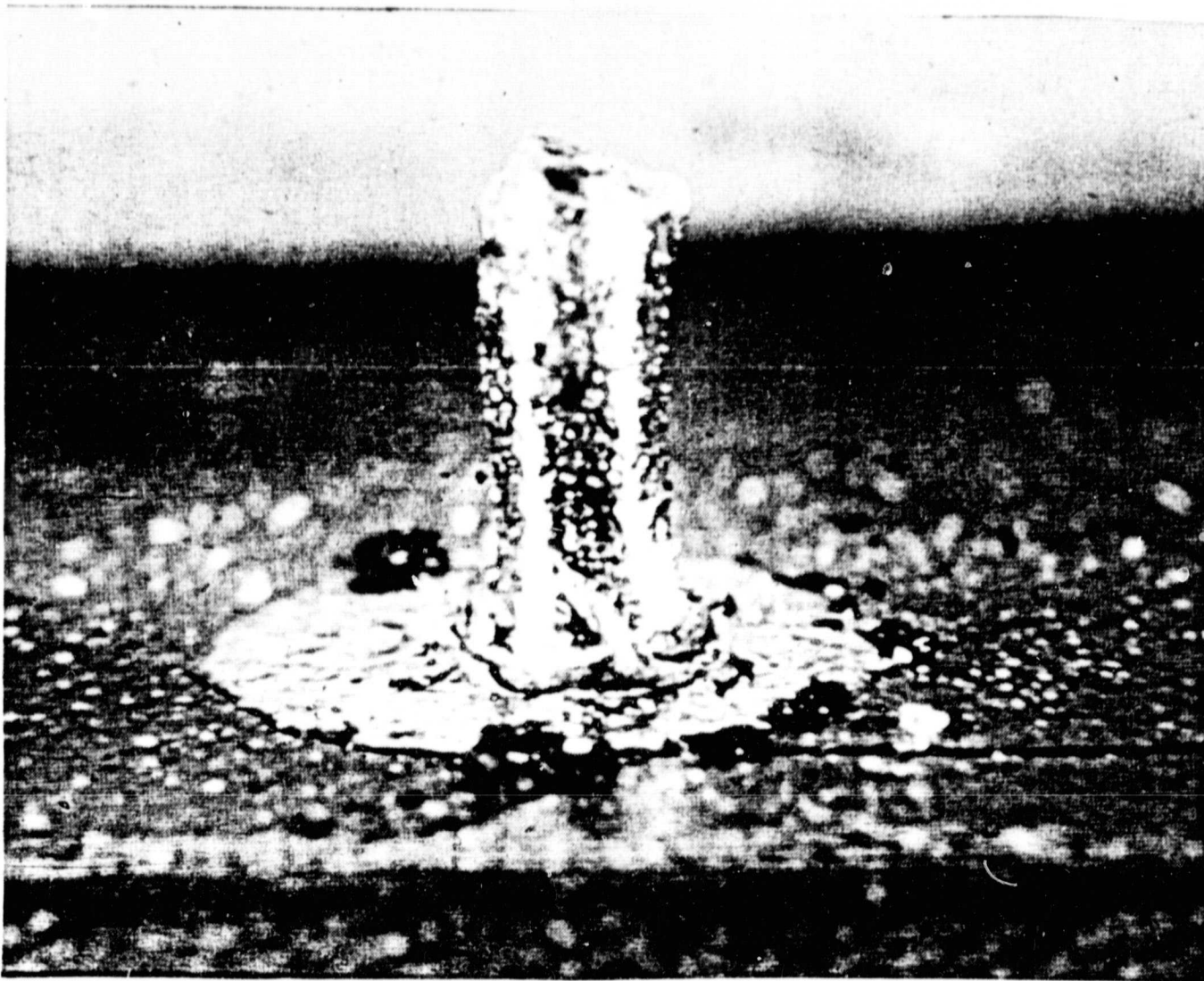
NASA

ORIGINAL FILED IN
OF PUBLIC LIBRARY



AC INDUCTION MOTOR CONTROL
ENERGY SAVING DEVICES FOR CONSUMER APPLICATIONS.

ORIGINAL PAGE IS
OF POOR QUALITY

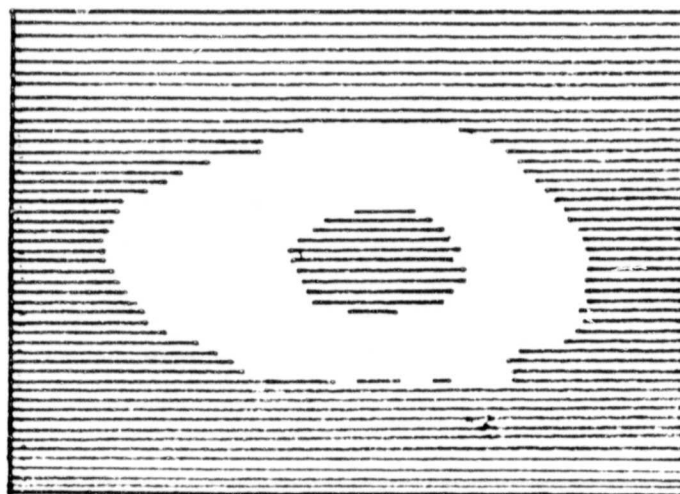


LACK OF SOLDER

**DEFECTIVE
SOLDERED LEAD**

ORIGINAL PAGE IS
OF POOR QUALITY

**CRT DISPLAY OF LASER
GEOMETRY DATA
ILLUSTRATING DEFECT
ABOVE**



AUTOMATED PRINTED CIRCUIT BOARD INSPECTION

**NONDESTRUCTIVE TESTING OF SOLDERED JOINTS IN PRINTED
CIRCUIT BOARDS USING LASER TECHNOLOGY.**